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THE EFFECT OF HARVESTING RUSTED WHEAT EARLY.

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Introduction.

Under the conditions of an epidemic of black stem rust of wheat many people are in doubt as to the proper time for cutting their crops. The kernels of wheat that is heavily attacked by this disease are cut off more or less completely from their supplies of moisture and food. Although there seems to be no sound basis to justify the practice, such wheat is frequently harvested considerably "on the green side" with the expectation of securing increased yields of better quality grain than would be had if the crop were cut at the normal time. Wheat that is only moderately rusted is also frequently cut green. Apparently the question of when to cut rusted wheat is still a problem in the minds of many agriculturists.

The problem is not a new one. Bracken *(3)* reported the results obtained at Saskatoon when wheat was cut at different times previous to maturity in the rust epidemic season of 1916. He found that the weight per measured bushel, the grade and the weight per 1,000 kernels increased decidedly between the milk stage or early dough stage of the kernel and maturity. The average increase in 1,000 kernel weight between the first cutting (on August 18th) and the last (on August 26th) for the varieties used (Marquis, Red Fife and Taylor's Wonder) was 8.41%. As relative weight per 1,000 kernels is a direct expression of relative yield the results indicated clearly that in the material studied early cutting would not have been wise.

Ellis *(4)* obtained similar results at Winnipeg in 1919. He harvested wheat that was badly infested with black stem rust at three day intervals commencing at the late milk stage. The wheat was cured in shocks in the usual manner. The grain cut in the late milk stage weighed 56 pounds per bushel while that cut at the hard dough stage weighed 59 pounds per bushel. Wheat cut at the hard dough stage gave the highest yields. Ellis concluded that rusted wheat should not be cut earlier than grain not attacked by rust.

The results from two cuttings of Marquis wheat affected with black stem rust to the extent of 75 to 80 per cent were given by Stoa *(5)* in 1924. The first cutting was made when the spikes were beginning to change color and the grain was in the dough stage. The second cutting was made

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five days later when the wheat was ripe. The grain was cured in shocks out of doors. Grain from the early cutting was inferior to that of the second cutting in yield, weight per measured bushel, weight per 1,000 kernels and protein percentage, but some of these differences between the two cuttings were not significant. Flour from the early cut grain gave lower loaf volume and color than flour from the mature grain.

Arny *(1)* in 1926 made a thorough review of previous work on the time of cutting crops. He concluded that "harvesting crops grown primarily for their grain or seed before they have reached approximately full maturity does not improve the quality of the product."

In 1927 Arny and Sun *(2)* published the results of an extensive study of the time of cutting wheat and oats in relation to yield and composition. Marquis wheat was harvested daily commencing nine days before it was mature. Various methods of preparing and curing the samples were used. Their conclusions are in part as follows: "Cutting wheat and oats before they were mature resulted in reduction of yield when the harvested grain was cured in the shock......... Lower weight per bushel resulted from premature cutting........ There was an increase in weight per 1,000 kernels for wheat harvested up to the time kernels in the lower spikelets were in the medium dough stage (three days early)....... Failure of the yields per acre, weights per bushel, and weights per 1,000 kernels of wheat and oats cut at early stages of maturity and cured in the shock to approach that cut at later stages indicates that materials were not translocated to any extent from the straw to the grain after cutting. Weights per 1,000 kernels from the various cuttings were as great when dried rapidly in the oven as when cured slowly in the bag or shock."

There was an unusually heavy epidemic of black stem rust of wheat in Saskatchewan in 1927. As the occasion seemed opportune a detailed study was made of the results of cutting several varieties of wheat, all infected with rust, at different dates prior to maturity.

Description of Experiment.

Six varieties of wheat growing in one-fortieth acre plots* in a replicated variety test on summer-fallow were used. There were five varieties of *Triticum vulgare:* Red Fife, Kitchener, Renfrew, Early Red Fife and Marquis, all quite susceptible to stem rust, and one *durum* variety, Pelissier, which is only slightly susceptible.

Stem rust infection of the wheat commenced about the middle of July when the wheat was heading and owing to very favorable weather conditions it had assumed heavy epidemic proportions before the grain was out of the milk stage. It was evident several weeks before harvest that the yield and quality of the wheat would be severely affected by the rust. Careful notes on rust infection were taken on each plot. Stems taken from the six varieties at maturity are shown in Figure 1.

For the purpose of the present study random samples were taken at two or three day intervals from one plot of each variety commencing August

* On the investigation field of the Field Husbandry Department, University of Saskatchewan, College of Agriculture, Saskatoon.

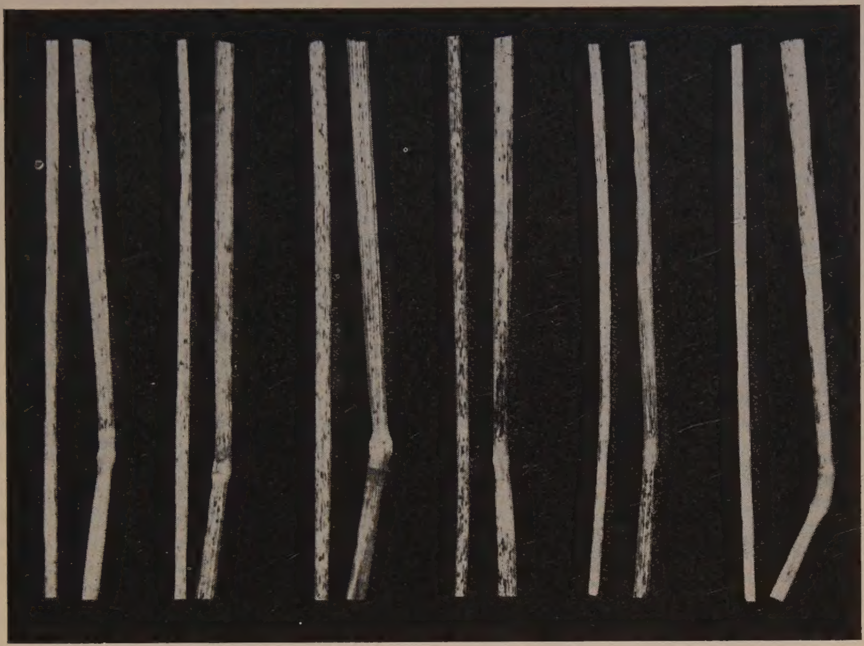


Figure 1. Wheat stems showing the average amount of infection with black stem rust at maturity. From left to right the varieties represented are Red Fife, Kitchener, Renfrew, Early Red Fife, Marquis and Pelissier.

24 and continuing until the wheat was ripe. On August 24 all of the varieties were in the soft dough stage excepting Early Red Fife and Marquis which were nearly in the hard dough stage. The seed of these two varieties was fully ripe on August 29 but the other varieties took from two to seven days longer to mature.

The six plots used occurred consecutively from East to West and had been seeded North and South with an ordinary grain drill, the rows being six inches apart. Ordinarily before these plots are harvested for yield tests the two outermost rows on each side are removed and discarded. These rows in the present case were left for use in the investigation. The random samples were taken from the row next to the outside row. A single sample consisted of the plants from two of every twelve feet of this row on each side of the plot.

The grain was cut about five inches from the ground with a sickle. Each sample was tied in a bundle and stooked along with other samples and extra bundles which were used to increase the size of the stooks and make the curing conditions similar for all the different varieties and as much like ordinary field stooking as possible. The grain for the extra bundles came from the outside border rows of the plots.

No attempt was made to compute yields because the weight, plumpness and grade of the grain were considered to be factors of greater accuracy and significance in this study. By careful sampling each lot of threshed seed was reduced to small portions that could be examined in detail in

the laboratory. These small samples were proved by extra tests to be representative of the original lots from which they came.

For the study of grain weight three 200 grain random samples were used for each variety. Each sample was weighed to the nearest .01 gram.

For plumpness determination a single 200 grain sample was used, this being in each case the one that was nearest in the weight study to the mean of the three samples taken. Each sample was separated into four classes: plump, slightly shrunken, shrunken and very shrunken. Each kernel was examined for plumpness and then placed in one of these classes. The first class included only grain of desirable plumpness, while kernels of the fourth class were wholly unfit for use as seed. The plumpness classes are shown in Figure 4.

Random samples of about 1,000 kernels each were graded according to the government standards for hard red Manitoba Northern wheat. In addition to ordinary grading each sample was classed as good, medium or poor of its grade by the use of +, blank or — following the grade designation. These samples were also judged for plumpness on a percentage basis according to the usual practice used for scoring grain for seed value.

Experimental Results.

Relative weights of random samples where each sample has the same number of kernels are true representations of yield, excepting for losses from shattering, saw fly damage or other causes that affect the *number* of kernels rather than their *weight* or plumpness; therefore the kernel weight results obtained in the present study were considered of major importance. It was observed that loss from shattering, saw fly damage or a weakening of the straw due to the rust was negligible in the material that was under investigation.

Table 1 gives the results obtained by weighing random 200 kernel samples taken in triplicate from each variety at two or three day intervals. The last column of the table shows the difference between the weights of grain at the earliest and the second last cutting. The second last cutting was made two or three days before maturity,† which is the approved time for cutting wheat under normal conditions.

Table 1.—*Effect of early cutting of wheat on the kernel weight of six varieties in 1927 when a heavy rust epidemic was present.*

Variety	Sask. No.	Average weight in grams of three 200 kernel samples and date of harvesting. Aug. 24	Aug. 26	Aug. 29	Aug. 31	Sept. 2	Sept. 5	Differences between weights for first and second last harvest dates in grams
Red Fife	73	3.68	3.87	3.86	4.08	4.08		+0.40±0.061*
Kitchener	34	3.20	3.31	3.45	3.04			+0.25±0.061
Renfrew	1203	3.89	4.15	4.16	4.30			+0.27±0.061
E. Red Fife	51	3.60	3.75	3.59				+0.15±0.061
Marquis	70	4.47	4.65	4.63				+0.18±0.061
Pelissier	41	7.38	7.58	7.85	8.23	8.44	8.04	+1.06±0.125
Average increase between first and second last dates								+0.39±0.028
Average increase between first and second last dates not including results for Pelissier								+0.25±0.027

* Probable errors were determined by Hayes deviation from the mean method.

† When the grain is in the hard dough stage, that is, when a reasonable amount of pressure must be exerted by the thumb nail to make a dent in the kernel.

It is apparent from the figures in Table 1 that there was a gain in weight of kernel from August 24 until maturity or near-maturity.

In general the kernels reached their maximum weight two or three days before maturity. It is clear that this was not the result of local fluctuations in the weather for the ripening of the different varieties spread over a period of six days. The average gain in weight of kernel between August 24th and the date of maturity both when Pelissier was considered and when the result for this variety was not included was highly significant. The average gain in weight of kernel between the first date of cutting and the second last was even more outstanding. Without considering Pelissier, on account of it being somewhat rust resistant, the gain was 0.250 ± 0.027 grams per 200 kernels or about 7%. The chances that this result has real significance are over ten billion to one. Stated differently, the results show that under the conditions of this investigation a definitely higher kernel weight was obtained by cutting two or three days before maturity than by cutting several days earlier. It is also important to note that each variety considered separately shows a marked increase in kernel weight up to two or three days before maturity. The kernel weight results are shown graphically in Figure 2.

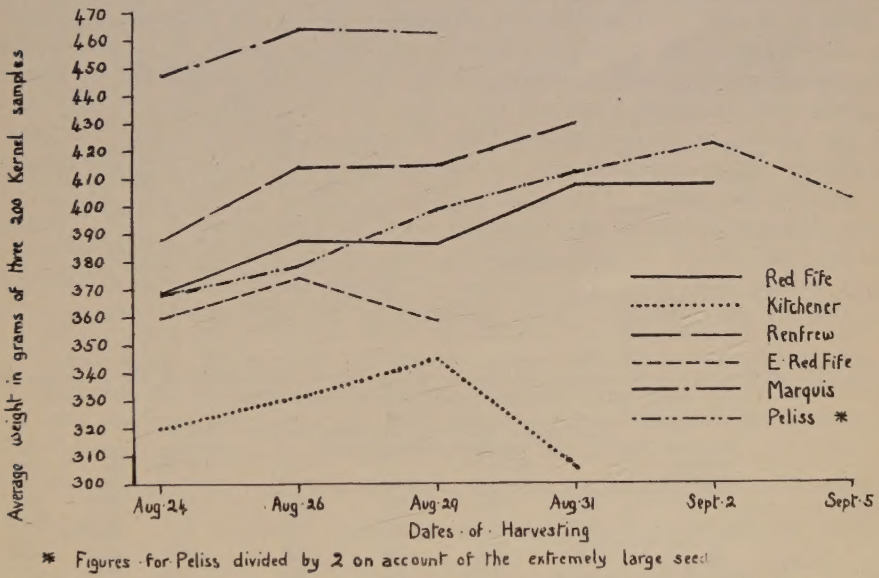


FIGURE 2. Average weight in grams of 200 kernels samples of six varieties of wheat cut at different dates before maturity. The increase of kernel weight up to two days before maturity is apparent.

The significance of the kernel weight results was also determined by the use of "Student's" method. Considering the difference between the weights of the August 24th cutting and those of the second last cutting the results were as follows: with Pelissier included $P = .9991$ giving odds of 1110 : 1 in favor of the second last cutting; with Pelissier omitted $P = .9977$ giving odds of 434 : 1 in favor of the second last cutting. Table 2 shows the use of the method on the results for the five common varieties.

TABLE 2.—*Biometrical determination by "Student's" method of the significance of the difference between the kernel weight of five rust-susceptible varieties of wheat harvested from five to nine days before ripe and the kernel weight of the same varieties when harvested at the normal time two or three days before maturity.*

	A*	B*	d	d²
Red Fife	3.68	4.08	.40	.1600
Kitchener	3.20	3.45	.25	.0625
Renfrew	3.89	4.16	.27	.0729
Early Red Fife	3.60	3.75	.15	.0225
Marquis	4.47	4.65	.18	.0324

$$5\,|\,18.84 \qquad 5\,|\,20.09 \qquad 5\,|\,1.25 \qquad \sqrt{\frac{.3503}{5} - (.25)^2}$$

$$3.77 \qquad 4.02 \qquad .25 = M \qquad .087 = S.D.$$

$$\frac{.25}{.087} = Z = 2.87$$

P = .9977, that is, the odds that the difference between 3.77 and 4.02 is significant are 9977 to 23 or 434 to 1.

* Average weight in grams of three 200 kernel samples from wheat harvested on (A) August 24th and (B) two or three days before maturity, respectively.

The effects of early harvesting on kernel plumpness are shown in Tables 3, 4 and 5. The different plumpness classes are pictured in Figure 3. In Table 3 the actual distribution of kernels in the different classes for plumpness is given. Considering all varieties the percentage of plump kernels was distinctly lower in the grain cut seven days before ripe than in the grain cut at the normal time two or three days before maturity. When the figures for Pelissier are omitted the result is less striking though essentially the same. There was 13.2% of plump kernels and 31.6% of very shrunken grains in the wheat cut seven days early but 20.7% of plump kernels and 24.1% of very shrunken ones in the wheat cut two or three days before maturity. The number of plump kernels increased and the number of very shrunken ones decreased as the crop neared maturity.

TABLE 3.—*Effect of early cutting of wheat on the kernel plumpness of six varieties in 1927, when a heavy rust epidemic was present.*

Varieties	Number of days before ripe	Distribution of kernels according to their degrees of plumpness. Plump	Shrunken slightly	Shrunken	Very shrunken	Total number of kernals	% Plump	% Very shrunken
All	7	170	193	222	206	791	21.5	26.0
"	5	206	215	217	179	817	25.2	21.9
"	2 to 3	234	225	199	150	808	28.9	18.6
"	0	211	235	217	148	811	26.0	18.2
Without Pelissier	7	78	127	199	187	591	13.2	31.6
" "	5	105	157	185	165	612	17.1	26.9
" "	2 to 3	124	157	173	144	598	20.7	24.1
" "	0	107	164	202	138	611	17.5	22.6

Table 4 gives the results on a varietal basis. Here, the plumpness value of a single cutting of a variety is expressed in one number. While the individual varieties do not show progressive increase of kernel plumpness in all cases there are certainly no cases where anything like significant decreases occurred. In general, plumpness of kernel increased with approaching maturity.

TABLE 4.—*Effect of early harvesting of several varieties of wheat on the kernel plumpness under the rust epidemic conditions of 1927.*

Variety	Sask. No.	Coefficient of plumpness* of kernels for different dates of cutting.						Differences between the plumpness coefficient of Aug. 24th cutting and that of 2nd last cutting.
		Aug. 24	Aug. 26	Aug. 29	Aug. 31	Sep. 2	Sep. 5	
Red Fife	73	499	457	526	553	506		54
Kitchener	34	393	376	425	416			32
Renfrew	1203	448	497	486	513			38
Early Red Fife	51	445	435	403				–10
Marquis	70	611	608	595				– 3
Pelissier	41	564	604	631	640	669	669	105
Average increase between first and second last dates								36
Average increase between first and second last dates without Pelissier								18

* Obtained by weighting the different plumpness classes by multiplying the number of plump kernels by 4, the number of slightly shrunken kernels by 3, the number of shrunken kernels by 2 and the number of very shrunken one by 1, then adding the four figures together and correcting the sum for any difference between the total number of kernels examined and the average total number for the variety.

The results on kernel plumpness for the varieties Red Fife, Kitchener, Renfrew, and Pelissier are shown graphically in Figure 3, by representing the actual percentages of plump and very shrunken kernels for four dates of cutting commencing one week before maturity. Marquis and Early Red Fife are not included owing to no material being harvested earlier than five days before they ripened.

The earlier the wheat was cut the lower was the proportion of plump kernels. The grain cut one week before maturity was 21.3% plump and 25.8% very shrunken. Two days later the percentages were 25.8 and 22.4, respectively, for these classes. Grain cut two days before ripe had 29.3% of plump kernels and only 18.8% of very shrunken ones. These results not only show no advantage in early cutting under the conditions of the experiment but show a distinct advantage in delaying cutting of the rusted grain until the usual time two days before ripe.

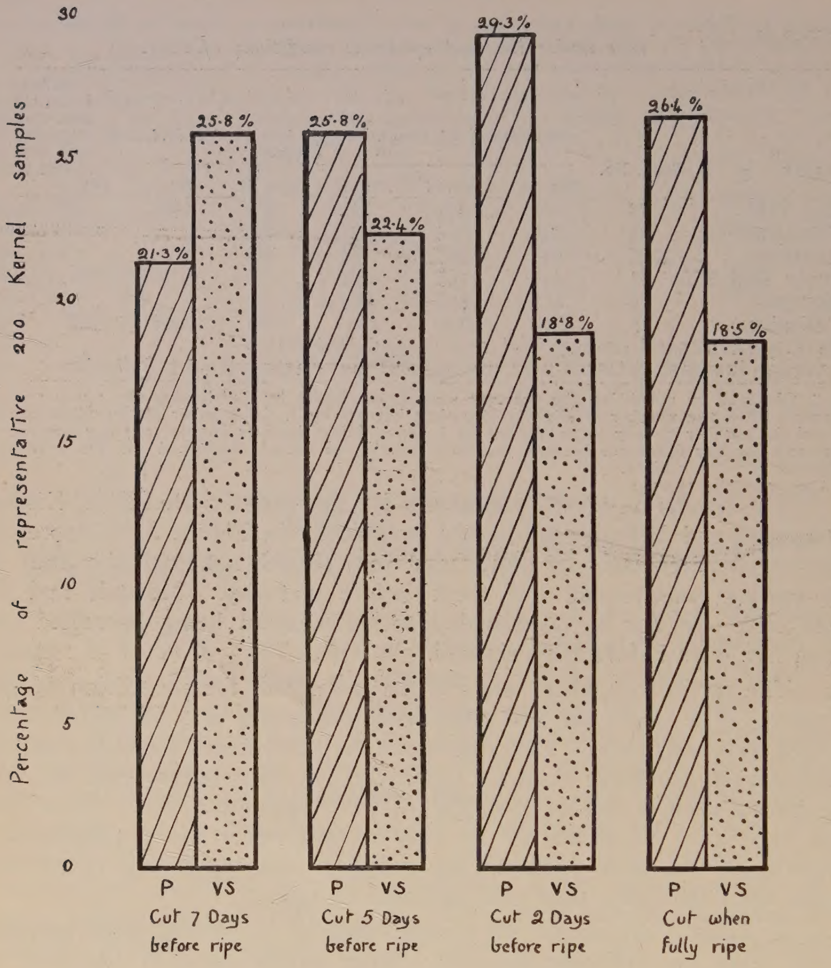
In Table 5 are shown the results obtained by scoring large samples of grain from the different dates of cutting on the basis of the seed grain score card. In general the figures agree with those secured by the more painstaking method of classifying each kernel separately. To insure that the scoring was impartial the samples were arranged at random under fictitious numbers of no significance to the judge.

TABLE 5.—*Kernel plumpness of rusted wheat determined by the score card method.*

Variety	Sask. No.	Percentage plumpness of representative samples from wheat cut at different dates.					
		Aug. 24	Aug. 26	Aug. 29	Aug. 31	Sept. 2	Sept. 5
Red Fife	73	50	50	50	55	50	
Kitchener	34	35	35	45	40		
Renfrew	1203	40	40	50	45		
Early Red Fife	51	40	45	45			
Marquis	70	60	70	65			
Pelissier	41	75	75	75	80	80	85

Average percentage plumpness for first date of cutting of all varieties = 50; for second last date = 58. Difference = 8%. By "Student's" method the odds are 1666 to 1 that this difference is significant.

After the samples were scored for plumpness they were graded according to federal standards. The results appear in Table 6. Excepting



Note; P= plump, VS = very shrunken. These are the two extreme classes for plumpness. Figures on the two intermediate classes are given in Table. I.

FIGURE 3. Effect of time of cutting on the kernel plumpness of four varieties of wheat as shown by a comparison of the percentage of plump kernels with the percentage of very shrunken kernels for each of four dates of cutting.

TABLE 6.—*Effect of early cutting of rusted wheat on the grade.*

Variety	Sask. No.	Grading of representative samples, from wheat cut at different dates.					
		Aug. 24	Aug. 26	Aug. 29	Aug. 31	Sept. 2	Sept. 5
Red Fife	73	6	6	6	6	6	
Kitchener	34	F+*	F	6–	F		
Renfrew	1203	6–	6–	6–	6		
Early Red Fife	51	6–	6–	6–			
Marquis	70	5–	5	5			
Pelissier	41	3–	2	2	3–	2–	2

* The signs + and — are used in order to indicate as closely as possible the grade value of each sample, viz: 6— means a poor 6; F+ means a good feed sample. The Canadian Government's official grain standards were used in the grading.

for Pelissier no important differences in grade were found between samples for the different dates of cutting. However a tendency toward grade improvement as the grain approached maturity is observable in the figures.

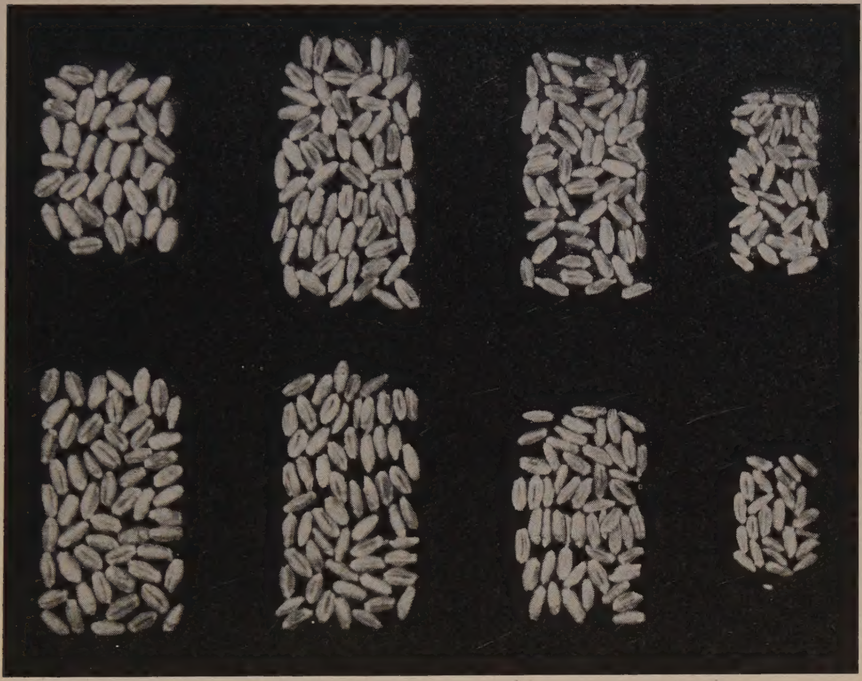


FIGURE 4. Distribution of representative 200 kernel samples from two dates of cutting of Red Fife. Top row: grain harvested nine days before maturity. Lower row: grain harvested two days before maturity. From left to right in each row the kernels are placed in four plumpness classes: plump, slightly shrunken, shrunken, and very shrunken. Note the relatively high proportion of plump grain for the cutting two days before ripe.

All of the results presented in Tables 1 to 6 show the effect of early cutting on wheat in general, there being six representative varieties used. It is of interest to compare the different varieties, one with another, for their plumpness, grade and percentage of rust infection. This is done in Table 7. The six varieties vary from 2 — to F + in grade and from 82 to 40 in percentage plumpness, considering only the last three dates of harvesting (as Marquis and Early Red Fife only had three). Pelissier gave a much plumper, better grading sample than the others on account of its partial rust resistance. Marquis being slightly earlier than the others took second place. Early Red Fife although ripening as soon as Marquis gave poor results owing to its high rust susceptibility. Kitchener gave the poorest results although not much different from Renfrew and Early Red Fife.

TABLE 7.—*Effect of early cutting of rusted wheat on the plumpness and grade of six varieties in relation to the rust susceptibility of each variety.*

Variety	Sask. No.	Average % plumpness for last 3 dates of harvesting	Average grade for last three dates of harvesting	Average % stem rust infection
Red Fife	73	52	6	73
Kitchener	34	40	F+	69
Renfrew	1203	45	6–	67
Early Red Fife	51	43	6–	71
Marquis	70	65	5	65
Pelissier	41	82	2–	12

Discussion

The results obtained by cutting wheat at different dates prior to maturity at Saskatoon in 1927 show that under the conditions of the experiment the grain, although badly rusted, gained in kernel weight and plumpness until two days before it was ripe. The rust epidemic at Saskatoon was severe and probably very similar to a normal heavy epidemic in other districts. The ordinary yield test plots were used for this study. The investigation was not planned until the rust epidemic was at its height and no changes were made in the management of the plots except the delaying of the removal of the border rows, so that they could be used for the experiment. Although several of the varieties used in the investigation showed high susceptibility to rust there was no evidence in favor of early cutting.

There is a very prevalent opinion among farmers that it is advantageous to cut rusted wheat earlier than the usual time of harvesting. Cutting slightly earlier than usual in order to avoid saw fly damage, hailstorms or the shattering of an easily-shattered variety should not be confused with early harvesting to avoid rust damage. When wheat is very heavily rusted as early as the milk stage of the kernel it may not be worth cutting. Such a crop will be very poor in yield and grade if cut early; it will likewise be very low in these qualities if cut at the usual time. In other words, a crop already ruined cannot be improved by any method of harvesting. When wheat is badly rusted the straw becomes weak and may break over at or near the top joint of the stem. In 1927 this was observed to occur in the extremely susceptible variety Early Red Fife, but not until several days after the wheat was dead ripe.

The opinion that rusted wheat should be cut early has been proven to be erroneous. The present piece of work is not alone in showing that it is better to cut rusted wheat at the normal time. Bracken *(3)* demonstrated this in 1916 and since then both Ellis *(4)* and Stoa *(5)* have furnished evidence. These four pieces of work were done at three widely separated places in the hard red spring wheat area of North America under different climatic and soil conditions. The general conclusion reached may therefore be considered applicable throughout this area.

Summary.

1. Under heavy stem rust epidemic conditions at Saskatoon in 1927 representative samples were cut from six varieties of wheat at intervals of two or three days commencing August 24th and ending when the varieties were ripe.

2. Average kernel weight, considering all of the varieties together, showed significant increase from August 24th until two days before maturity. When the results for Pelissier, the one durum variety in the test, were omitted there was still a notable increase in weight of kernel in favor of cuttings made two days before maturity.

3. There was a definite increase in kernel plumpness during the week before maturity. Wheat cut a week before ripe had a larger proportion

of very shrunken kernels and a lower proportion of plump kernels than wheat cut two days before ripe.

4. No significant differences in grade were obtained although there appeared to be a tendency for the wheat to improve in grade during the period of a week prior to maturity.

5. The existing opinion in favor of harvesting rusted wheat a week or more before it is mature is not based upon facts. The results obtained at Saskatoon in 1927 show conclusively that rusted wheat should be harvested, like unrusted wheat, at the normal time two or three days before it is fully ripe. Harvesting it earlier than this results in loss due to incomplete filling of the kernels and subsequent shrinkage as shown by the kernel weight and plumpness of wheat cut at different dates.

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AGE AS A FACTOR IN SWINE REPRODUCTION.

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Casual observations have been made from time to time on the influence of the age factor in swine reproduction, and certain data have been presented relative to the question. With a view to supplementing the rather meagre supply of information which was available on this question, a study was made of the farrowing records at the University of Alberta, covering the years 1922 to 1926 inclusive. It was hoped that a study of this kind would reveal some situations which would be of practical as well as scientific interest and, being based on some 270 farrowings, the writers feel that a fair measure of significance may be attached to the findings.

Length of Gestation Period.

Text books and bulletins state the average gestation period for sows to be approximately 112 days. Day *(1)* suggests a period of "about 112 days". Coburn (*2*) quotes an average of 112 days with young sows carrying their young from 106 to 108 days, and older ones running to 115 days. Dietrich *(3)* states the gestation period to be approximately 114 days. The following table shows the gestation periods of sows of five different breeds at the University of Alberta, classified according to age:

Table 1. *Length of gestation period—278 sows.*

Age (Years)		Number of Sows		Length of Gestation Period
1		101		114.58
2		77		114.30
3		51		114.78
4		34		114.48
5		15		115.47
	Total	278	Average	114.62

It is to be noted from this table that the length of the gestation period is remarkably constant for the sows ranging in age from one to four years. The sows farrowing at one year of age carried their pigs as long as the four year old sows. Whether or not the 115.47 day period for five year old sows can be regarded as significant will depend upon the reliability of a figure based on 15 farrowings. It probably indicates that the sow which may be regarded as "aged" is due for a longer period of "expectancy."

Prolificacy.

It has long been recognized that there is a definite relationship between age and size of litter. It has been regarded as a fundamental principle that the size of the litter increases with the age of the sow until a maximum is reached, to be followed by a decrease in prolificacy. The following table verifies this established principle:

Table 2.—*The influence of age on size of litter.*

Age (Years)	Number of Sows	Average Size of Litter
1	101	8.109
2	77	9.701
3	51	9.706
4	33	9.97
5	15	9.53

It would seem, however, that the age factor in relation to size of litter is more prominently to the fore in the early stages of the brood sow's history than in later years. The difference in size of litters between yearling and two year old sows is quite marked, the increase due to age being 1.6 pigs. Thereafter and up to four years the increase is slight. It would appear that with sows raising on the average three litters every two years, the maximum in size of litter is attained at an age of four years, or by the time the sixth or seventh litter has been farrowed.

Number of Still-born Pigs

The still-born pig is a factor which has to be reckoned with when the economics of swine production are under consideration. The pig which is born dead is a liability and a contributing factor to higher overhead costs. Various environmental factors have been pointed to as the causes of pigs suffering an intra-uterine demise. Table 3 as well as the accompanying chart indicates that the age of the sow is related to this condition.

Table 3.—*Influence of age on percentage of still-born pigs.*

Age (Years)	No. of Sows	Pigs Farrowed	Percentage Pigs Born Dead
1	101	819	6.50
2	77	747	7.08
3	51	495	11.92
4	33	329	12.77
5	15	143	20.98

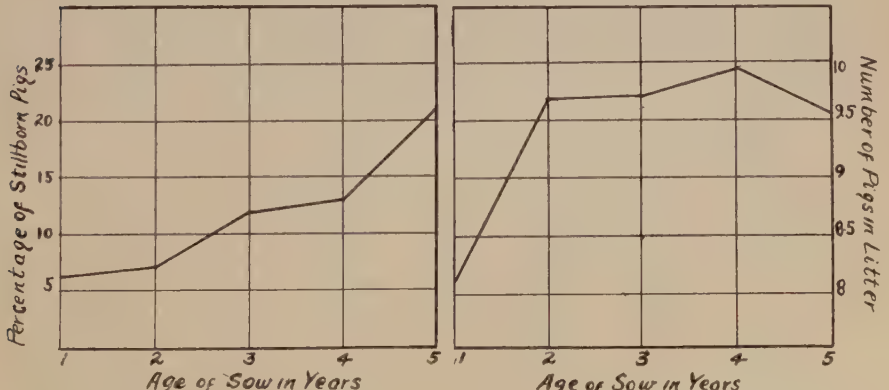

Chart showing influence of age on size of litter and percentage of still-born pigs.

There appears to be a steady increase in the percentage of still-born pigs as the sows increase in age. In view of the fact that iodine deficiency was taken care of by the ordinary means of administering potassium iodide during the entire pregnancy period, some other explanation than thyroid derangement must be sought. It may be that intra-uterine congestion, due to increase in size of litter and size of individual, and an increased demand for fetal nourishment as the sow increases in age, are conditions which contribute to the progressive pre-natal mortality. Any serious attempt at explanation of this occurrence must, however, be reserved until the matter is studied in detail.

The Sex Ratio.

A study of the proportion of males to females in 277 farrowings indicates a preponderance of males and does not seem to show any relation between age and the sex ratio.

Table 4.—*The influence of age on the sex ratio.*

Age (Years)	No. of Sows	No. of Pigs farrowed	Percentage of males	Percentage females
1	101	819	53.48	46.52
2	77	747	54.09	45.91
3	51	495	54.75	45.25
4	33	329	51.37	48.63
5	15	143	54.45	45.55

The ratio between the two sexes appears to remain quite constant with sows of various ages and in no case is there a reversal of the male over female dominance. Of the 2,533 pigs farrowed by 277 sows 53.69 per cent were males and 46.31 per cent were females.

Percentage of Pigs Crushed.

Every swine raiser is acquainted with the fact that loss of pigs at farrowing or immediately subsequent to farrowing contributes to higher overhead costs. The degree of loss will largely depend on the methods of management practised at farrowing time. The temperament of the sow must also be considered. With the management factor under control, and disregarding temperament which differs with breeds and individuals within a breed, has the question of the age of the sow a bearing on the percentage of pigs crushed at farrowing? Table 5 is submitted for consideration on this point.

Table 5.—*The influence of age on number of pigs crushed.*

Age of Sow (Years)	No. of Sows	No. of Pigs Farrowed	Percentage Crushed
1	101	819	7.33
2	77	747	8.15
3	51	495	6.26
4	33	329	11.59
5	15	143	9.79

While the percentage of casualties does not increase regularly as the sow attains age and weight, the tendency is toward a heavier loss with the

older sow. The nearest approach to perfect maternal instinct is to be found in the case of the three year old sow raising on the average a fourth litter. Four and five year old sows show a comparatively poor record. When this fact is considered along with those arising out of the previous tables, it would seem that the degree of farrowing efficiency falls off rapidly after a sow reaches the age of three years.

Birth Weight of Pigs

It has been a common belief that the mature sow gives birth to larger, stronger pigs than the young, immature sow. While no statement can be made regarding the vigor of the pigs farrowed by sows of different ages, this study produces evidence that the birth weight of the pigs increases slightly as the sow advances in stage of maturity. Table 6 deals with this question.

Table 6.—*Age of sow in relation to birth weight of pigs.*

Age of Sow (Years)	No. of Sows	No. of Pigs	Av. Birth Weight Pounds
1	101	819	2.45
2	77	747	2.55
3	51	495	2.65
4	33	329	2.59
5	15	143	2.69

The difference in the average birth weight between pigs farrowed by one year old sows and five year old sows is not great, being only .24 pounds in favor of the latter. From the practical point of view the mature sow has little advantage over the young sow in this regard. The average birth weight of the 2,533 pigs studied was 2.58 pounds.

Weight of Pigs when Weaned.

The weight at which a pig is weaned has a considerable bearing on its future development and may be the deciding factor as to whether its relation with the owner will be harmonious or otherwise. This is especially true in areas where protein supplements are not abundant and where balancing elements in the ration are likely to be deficient. Under these conditions a few additional pounds in the weaning weight of pigs constitute a valuable asset. It is to be expected that with advancing age and an increase in the number of lactation periods, the milk production of the sow will increase and as a result the suckling litter will be better nourished. Table 7, which is based on a study of pigs weaned at eight weeks of age, bears evidence that the pigs weaned by mature sows are better developed than those from younger sows.

Table 7.—*Influence of age of sow on weaning weight of pigs*

Age of Sows (Years)	No. of Sows	No. of Pigs	Average weaning weight
1	83	484	27.64 pounds
2	72	473	31.75 "
3	45	303	33.32 "
4	30	203	35.25 "
5	15	79	33.43 "

Pigs weaned by four year old sows were on the average 7.6 pounds heavier than those weaned by year old sows. There appears to be a gradual increase in the weaning weight of pigs with sows from one year old up to four years old. If the figure for five year old sows could be regarded as significant, it might be stated that a decrease in milk production occurred at the five year old stage, resulting in pigs of a lighter weanling weight.

Conclusions.

The foregoing study is presented by way of general interest rather than as an attempt at any serious explanation of particular occurrences. The writers feel that the data presented are of greater value than the accompanying discussion. It is realized that the lack of numbers of individuals in certain cases limits the deductions which may be drawn. By way of conclusions we set forth the following principles, to which we feel a fair degree of reliability may be attached:

1. The length of the gestation period is constant for sows of all ages. The average period for 278 sows was 114.6 days.
2. The sow appears to reach her maximum degree of prolificacy at four years of age or with the sixth or seventh litter.
3. The sex ratio remains quite constant as the sow advances in age. Of 2,533 pigs farrowed 53.69 per cent were males and 46.31 per cent were females.
4. The age of the sow seems to be a factor in the production of still-born pigs. An advance in age is accompanied by an increase in the percentage of pigs born dead.
5. Aged sows crush a higher percentage of pigs at farrowing time than young sows. Environmental factors and variations in the temperament of sows appear to be more important items in connection with farrowing losses, however, than the age of the sow.
6. An increase in the age of the sow is accompanied by an increase in the birth weight of the offspring.
7. The average birth weight of 2,533 pigs included in the study was 2.58 pounds.
8. The age of the sow has a distinct influence on the weaning weight of the litter. Mature sows wean off heavier pigs than young sows.

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LIFE-HISTORY NOTES ON TWO SPECIES OF SAWFLY INJURIOUS TO THE FRUIT OF THE CHOKE CHERRY*

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(Received for publication January 9, 1928)

The choke cherry, *Prunus virginiana* L., is perhaps the commonest native fruit tree of the Prairie Provinces. It is found growing plentifully along the border of the poplar woods and although the fruit is somewhat astringent it is used to a considerable extent as a food by man as well as by many mammals and birds.

The large racemes of white flowers appear in the latter half of May and their fragrance and supply of pollen and nectar attract many insects among which are two small and closely related species of sawfly. The small size and yellowish-white colour of these sawflies cause them to blend with the flowers so that they would escape notice were it not for their active movements. These two sawflies, *Hoplocampa xantha* Rohwer and *H. lacteipennis* Rohwer, in return for their services in fertilizing the flowers, extract a heavy toll from the cherry. The adults not only eat large quantities of nectar and pollen, but the females deposit their eggs in the calyx of the flower and the larvae destroy the developing fruit.

Life-history studies of both species were begun in 1925 and continued in 1926. Mating and oviposition were observed by enclosing the adults in glass vials with fresh racemes of flowers and as the period to which the flowers are subject to the egg laying of the sawflies is very brief, the remaining data on the life-histories were obtained by daily examination of the infested berries.

Although the sawflies belong to the same genus, interesting differences in their life-histories were found, as will be noticed in the following account.

Hoplocampa xantha ROHWER

This sawfly was originally described by Rohwer *(2)* in 1911 from four females in the Ashmead collection taken at Ottawa, Ont. It has been collected in Manitoba at Aweme and Wawanessa, and in Saskatchewan at Oxbow *(3)*. As far as is known, its only food plant is *Prunus virginiana* L.

The life-history of *Hoplocampa xantha* Rohwer is very similar to that of *H. halcyon* Norton *(6)*, which feeds on the fruit of the saskatoon, *Amelanchier spicata* (Lam.) C. Koch.

The *egg* has a white, shining, flexible chorion, in outline of the form of an ellipse flattened on one side, and measures about 0.75 mm. in length by 0.4 mm. in width when newly laid. During the incubation period of about five days it enlarges considerably. The eggs are deposited singly under the outer epidermis high up in the calyx at the base of a sepal of a choke cherry flower. The female does not appear to be able to

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† I acknowledge with pleasure many helpful suggestions in preparing the following notes, received from my chief, Mr. Norman Criddle, entomologist in charge of the Treesbank Laboratory Man.

distinguish between fertile and sterile flowers and for this reason many eggs perish as a number of the flowers in a raceme do not produce fruit.

Full grown *larvae* measure about 7.0 mm. in length. When removed from the cherry they move actively about by means of their well developed legs. The skin is smooth and marked by five indistinct annulets on the abdominal segments. The spiracles are situated on the prothorax and abdominal segments 1 to 8. The antennae are very short and four segmented. The labial palps consist of two segments and the maxillary palps of four. A key to the instars of this larva and a detailed description of the external anatomy of a closely related species was published in 1927. *(7)*.

Careful observation indicates only four larval instars. This is surprising as both *Hoplocampa halcyon* Norton *(6)*, and *H. pyricola* Rohwer *(5)* have five instars. *Hoplocampa lacteipennis* Rohwer however, also, has only four instars. With each instar the larva enters a fresh fruit by boring from the side directly into the newly formed seed which is still soft and pulpy. The cast skin of its preceding instar is left behind in the old berry which has been eaten to a shell. The instars may be separated by the size of the body, head capsule, the pigmentation of the terga of abdominal segments 8, 9 and 10 and other characters which may be described for each instar.

In the *first instar*, the head capsule and labrum are light brown. The mandibles are also light brown with the tips darker. The tergum of the 10th abdominal segment and often the posterior margin of the 9th is black. The remainder of the body, legs and mouth parts, are a translucent white. About three days are spent in this instar during which the length increases from 1.23 mm. to nearly 2.0 mm. The width of the head capsule is 0.29 mm.

In the *second instar*, the head capsule, labrum and mandibles are of a blackish-brown. The tips of the mandibles, the articulations between the segments of the thoracic legs, the terga of abdominal segments 9 and 10, and the posterior margin of the tergum of segment 8 are black, otherwise the color is as in the first instar. The length increases from nearly 2.0 mm. to nearly 4.0 mm. in the three to four days spent in this stage. The width of head capsule varies from 0.40 mm. to 0.45 mm.

The *third instar* has the entire tergum of the abdominal segments 8, 9 and 10, black as well as a small area on the distal side of the last pair of prolegs, otherwise the stage is as in the second instar. Five or six days are spent in this stage in which the length increases from 4.0 mm. to just over 5.0 mm. The width of the head capsule is 0.65 mm.

In the *fourth instar*, the head capsule, labrum and mandibles are yellowish with the tips of the mandibles black. The terga of the abdominal segments 8, 9 and 10 are of a light yellowish-black spotted with black. The joints of the thoracic legs and the distal side of the last pair of prolegs are not pigmented, otherwise this stage is as in the third instar. In the five or six days spent in this stage the length increases from 5.0 mm. to 7.0 mm. The width of head capsule is 0.82 mm.

The larvae when full grown, 16 to 20 days after hatching, leave the last cherry attacked through the entrance hole, drop to the ground, and

depending upon its hardness, enter to a depth of from 1 to 3 inches, spin a cocoon and become dormant before pupating the following spring. In the two years of observation it was found that the majority of the larvae had entered the ground by June 20.

The *pupa* was not studied nor was the pupal period determined exactly though it is probably very short.

The *cocoon* has a papery texture and is made of brown silk to which particles of earth adhere. It is oval in outline, slightly greater in diameter at the cephalic end, and measures about 4.5 mm. in length by 1.7 mm. in width.

The *adult* is small and reddish-yellow in colour with a relatively large black area on the tergum of the abdomen and part of the thorax, the extent of which varies with the individual and the sex. The antennae and a small area about the ocelli may, also, be blackish. The length varies from 3.7 mm. to 4.0 mm.

The time of emergence of the adults varies with the weather conditions of the spring and coincides with the opening of the choke cherry flowers, which occurs about the last week of May. By the middle of June the cherries have finished flowering and the adult sawflies have died. In warm weather they are very active, but in cold and wet periods they become sluggish and hide in the flower clusters and beneath the leaves of the host. Like many other sawflies they feign death for a few seconds when swept into a net and are strongly negatively geotactic and positively phototactic.

Mating and oviposition were frequently observed and in these habits this species very closely resembles *H. halcyon* Norton *(6)*. When about to oviposit the female secures a firm foothold on the calyx of a choke cherry flower, bends the tip of the abdomen down so that it is almost at right angles to the thorax, feels about for a few seconds with the tip of the sheath and proceeds to insert the saw under the outer epidermis. When it is in to its full length it is swung through the arc of a circle toward the ventral side of the abdomen so as to make an almost semicircular pocket, then back again, so as to clear the cut. The egg is then laid and the saw withdrawn. Egg laying is interspersed between periods of mating and feeding. As in the case of *H. halcyon* Norton the choke cherry flowers are only subject to the attack of the sawfly for about two days, from the time the petals are about to unfold until the time they fall. The sepals have then curled back and hardened and the sawflies do not oviposit in them.

No parasites have yet been reared but several larvae of an ichneumon were found feeding externally on larvae of the fourth instar. Ants and birds prey to a limited extent on the adults and migrating larvae, but the most important means of natural control is brought about by meterological conditions, which prevent the maturing of the fruit, a late frost being the most effective.

Hoplocampa (MacGillivaryella) lacteipennis Rohwer

This species of sawfly was originally described by Rowher *(1)* in 1910, from specimens taken in Massachusetts. In Manitoba it has been

collected at Treesbank and Wawanessa. As far as is known its only food plant is *Prunus virginiana* L. The life history of *H. lacteipennis* Rohwer resembles that of *H. xantha* Rohwer but the habits of the larvae show many striking differences.

The *egg* is deposited in a similar manner to that of the preceding species and resembles it save in its larger size which corresponds to the larger size of the adult. It hatches in about five days.

The general morphological characters of the *larva* of this species are the same as those of *H. xantha* Rohwer and like them they pass through only four instars. Their pigmentation and habits however are quite different and these characters are discussed in the following descriptions.

In the *first instar*, the head capsule, labrum, mandibles, the tergum of the 10th abdominal segment and the segments of the thoracic legs are blackish-brown.,The tips of the mandibles are much darker. The remainder of the body is of a translucent white. Six or seven days are spent in this instar in which the length increases from about 1.3 mm. to 1.86 mm. The width of head capsule is 0.22 mm.

In this instar the habits are quite similar to those of *H. xantha* Rohwer but it will be noted that it is of longer duration. When the first cherry is eaten to a shell the larva moults and leaves it for a second cherry which it enters near the distal end.

In the *second instar* the head capsule, labrum, mandibles, terga of the 9th and 10th abdominal segments and the joints of the thoracic legs are brownish-black. The tips of the mandibles are darker. The remainder of the body is of a translucent white. In the three to four weeks spent in this instar the length increases from 1.88 mm. to 3.35 mm. The width of head capsule is 0.29 mm.

It will be noted that a very long time is spent in this instar. Instead of boring directly into the soft pulpy interior of the developing seed the larva eats a zig-zag tunnel in the wall of the hard outer part before entering the interior of the pit. While boring this long tunnel, which occupies about two thirds of the time spent in the instar, the growth of the larva is practically nil, but as soon as it enters the soft interior, growth is rapid and in a few days it casts its skin. In no case was it found that the larva entered another cherry.

The *third instar* has the head capsule, labrum, mandibles, segments of the thoracic legs and the terga of the 10th and part of that of the 9th abdominal segments light yellow. The tips of the mandibles are dark brown. Otherwise the appearance is as in the second instar. About ten days are spent in this stage in which the length increases from 3.4 mm. to 7.8 mm. The width of head capsule is 0.59 mm.

The second, third and fourth instars are all spent in the second cherry entered, which on account of the time spent in the second instar has grown sufficiently to supply enough food for the larva to complete its growth. There is no communication with the outside as the entrance tunnel becomes plugged with frass and cast skins.

In the *fourth instar* the head capsule, labrum and mandibles are yellow, the remainder of the larva is translucent white. In the eight to ten days spent in this instar the length increases from 7.8 mm. to 9.0 mm. and the body becomes relatively much plumper than in the third instar. The width of the head capsule is 0.88 mm.

The larvae complete their growth in from 45 to 55 days after hatching, at the time when the choke cherries are ripening, and leave the cherry by eating a hole directly to the outside. They drop to the ground, bore down several inches and spin a cocoon where they remain in a dormant state till they pupate the following spring. Usually all the larvae have entered the ground by the end of July.

The last cherry entered ripens with the others and only shows a slight shrivelling about the exit hole as practically none of the flesh has been destroyed. We might thus say that this species destroys one cherry and injures another, while *H. xantha* Rohwer destroys four.

The *pupa* has not been studied. The *cocoon* however resembles that of *H. xantha* Rohwer but is slightly larger, being 6.0 mm. in length by 1.8 mm. in width.

The *adult* is light yellow in colour with a relatively large black area on the tergum of the male. The length is from 5.0 mm. to 6.0 mm.

The time of emergence and habits of the adults correspond very closely to those of *H. xantha* Rohwer. The number of individuals, however, is greater. The females are more abundant than the males, but parthenogenesis must be very rare, if it occurs, as mating was very frequent.

The same factors of natural control as discussed for *H. halcyon* Rohwer affect this species. No experiments on artificial control have been carried out but adults could probably be killed by contact spraying, with a nicotine oil solution, in the early morning when sluggish, or by a poisoned sugar solution in the warm part of the day *(4)*. Spraying with arsenic when the larvae are migrating would kill many *(5)*. If the sawfly should attack cultivated varieties of cherries thorough cultivation of the soil under the bushes in the autumn or early spring should kill many hibernating larvae.

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SEED TREATMENTS FOR THE CONTROL OF SEEDLING BLIGHT IN CEREALS*

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Introduction

Since seed treatments have been recognized as good crop protection practises, much effort has been devoted to improving the agents used, as well as the method of application. When organic mercury compounds were introduced for smut control it was found that although they did not all control smut, many of them influenced the seed in such a way that emergence was undoubtedly increased. Treatments possessing such qualities could not be passed by without careful investigation to determine their merits. Recently considerable attention has been given to fungi which attack the young seedling, causing non-emergence and seedling blight. There appears to be some evidence to show that any injury to the seed or any factor which may cause retardation of germination predisposes such seed to attacks of fungi. The seed injury caused by some seed treatments has been considered in this light.

Kiessling *(14)* determined that formaldehyde, in ordinary seed treatment dosage, will cause injury to seed grain. Coons and McKinney *(5)*, in laboratory tests, found that wheat is more sensitive to formaldehyde than oats, barley or rye. Schaffnit *(19)* in testing various seed treatments, including mercuric chloride, formalin, copper sulphate and uspulun, against the Fusarium disease (*Fusarium nivale* Caes.) of rye, reported very favourably on the fungicidal properties and lack of injury of the organic mercury preparation, uspulun. Hurd *(12)* found that the ordinary formaldehyde treatment (1-320), did not cause much injury to wheat if germinated immediately after treatment. If the treated seed is dried rapidly without proper aeration paraformaldehyde is deposited, causing injury due to its extreme toxicity. This may happen when seed is sown in very dry soil which does not receive rain for several days. If the seed is sown in moist soil immediately after treatment, or stored under humid conditions, seed injury is not severe.

In later studies Hurd *(13)* reported that the embryo is relatively resistant to molds unless injured. Seed treatments, such as copper sulphate and formalin, tend to lower the viability of the embryos and thus expose them to infection. It is also pointed out that machine-threshed grain reveals a fair amount of seed coat injury, and the injured kernels serve as infection points. Tisdale *et al (20)* in reporting work on various seed treatments for the control of barley smuts, spoke favourably of the effect of chlorophol in increasing field germinations. Fraser and Simmonds *(6)* observed that various seed treatments gave a weaker germination in soil than on blotters. This was particularly true of formalin and sulphur, whereas copper carbonate was slightly better than the checks. Semesan and chlorophol, organic mercury

* Contribution from the Division of Botany, Experimental Farms Branch, Dominion Dept. of Agriculture, Ottawa, Ont.

compounds, were distinctly better than the checks. This brings up the question of seed injury and infection from fungi in the soil. Tisdale *et al* *(21)* mentioned increase in stand when machine threshed grain was treated with mercurial preparations.

Chistensen *(3)* found that none of the many treatments he used was entirely effective in killing the mycelium of *Helminthosporium sativum* in wheat and barley seeds. Treating the seed with fungicides did not affect the rate of growth of seedlings, nor did it control root rot or basal stem rot, or increase the yields when the seed was sown in soil in which the organism was present. Leukel *et al (15)* in a study of seed treatments for the control of barley stripe found that corona No. 620, caused a reduction in germination. S.F.A. No. 175 and tillantin at 1 per cent for two hours also caused injury to germination. Uspulun and semesan did not cause injury. Gassner *(8)* found that formaldehyde caused more injury at low than at high temperatures; the reverse seemed to be true with the mercurial preparations. The severe injury caused by formalin to spring sown grain in Western Canada may be partially explained on this basis. Lindfors *(16)* reported that mercurial treatments did not cause a stimulative action but have favourable fungicidal properties. Gram *(10)* mentioned increases in yields of wheat and rye when organic mercury treatments were used. Briggs *(2)*, in testing various seed treatments for the control of "bunt" in wheat, reported seed in jury for bluestone and formaldehyde, whereas chlorophol, corona No. 620, semesan, germisan, Dupont No. 12 and uspulun did not cause injury. The amount of injury depends somewhat upon the season. Conners (4), in his studies of seed treatments for the control of cereal smuts, found that formalin usually caused seed injury, whereas with semesan no retardation or injury to germination occurred. This treatment, however, did not satisfactorily control smuts. Greaney and Bailey *(11)* tried semesan as a seed treatment of wheat, oats and barley against *Helminthosporium* and *Fusarium* spp. They report some success and attribute this to seed stimulation.

From the above citations one can see that in connection with seed treatments two general phases must be considered: (1) direct seed injury caused by the treatments, (2) infection by soil fungi after the seed is sown. This has been pointed out by Gassner *(9)* in testing various treatments for the control of "bunt" in wheat. A seed treatment to approach perfection should not injure germination and should protect the seedling from infections of soil fungi during its early stages of development. It should likewise kill or retard fungi which may be on or in the seed.

Present Investigations

Extensive greenhouse tests have been carried out to determine the merits of certain seed treatments with regard to seed injury, protection against natural infections and protection against artificial inoculations. For the artificial inoculations two fungi, commonly found to be the cause of seedling blight disease of cereals, were used, namely, *Helminthosporium sativum* P.K. et B. and *Fusarium culmorum* (W. G. Smith) Sacc. Several pure cultures of *H. sativum* had previously been tested for their pathogenicity and

the most virulent isolation selected for this work. The culture of *F. culmorum* used was known to be very virulent.

Field tests, using some treatments to combat these fungi, were tried. Due to the lack of success in obtaining sufficient infection in the checks, and the inconsistent results of the treatments, it is not thought wise at the present time to attempt conclusions. Most of the treatments which gave protection in the greenhouse gave similar indications in the field. The greenhouse tests were in reality run as an elimination experiment. It is hoped that the most promising treatments will lend themselves to field tests. In this connection we are endeavouring to develop an inoculation technique which will be satisfactory for field work. The many factors attendant upon field experimentation of this kind necessitate years of observation and study. In the meantime the various treatments are being tested under severe disease conditions in the greenhouse.

Material and Methods

Soil: The soil was taken from arable land in the fall. Before potting it was mixed with river sand in the proportions of five to one. The mixture was not sterilized.

Seed: The following cereals were used—Marquis wheat, Banner oats, and Hannchen barley. These were considered of average vigor and freedom from disease.

Inoculum: An oat hull mash was used as a medium for growing the fungi. Ground oat hulls, obtainable from flour mills, when mixed with just enough water to make a damp mash, furnishes an excellent medium for the growth of these fungi. There appears to be sufficient meal to support growth, and the large proportion of hull material keeps the medium open. It is readily broken up and added to the soil. Such a mixture decreases the possible toxic effect which may result when whole grain mashes are used. The Fusarium cultures were approximately one month, and the Helminthosporium three weeks old, when used. A uniform sample of seven grams of the former and twenty grams of the latter was added to the respective pots in the inoculated series. This was placed at seed level and partly worked into the soil.

Treatments: The following solutions were used,—

1. Semesan, manufactured by E. I. Du Pont de Nemours & Co., Wilmington, Delaware.
2. Germisan, manufactured by Fahlberg, Liste & Co., Madgeburg, Germany.
3. Uspulun, manufactured by Bayer Co., Inc., New York, U.S.A.
4. Tillantin, a product of Farbewerke vorm. Meister, Lucius & Bruning, Höchst am Main.

The first three are organic mercury compounds, while Tillantin is an organic arsenic preparation with mercury or copper. For use these were made up with distilled water to a strength of 0.3 per cent. The seeds were soaked for a period of one hour and then air dried.

5. Formaldehyde, commercial, 1-320, soaked 5 minutes, covered 15 minutes, air dried.

The following dusts were used,—

1. Segetan—Trockenbeize, manufactured in Germany.
2. Urania —Trockenbeize, " " "
3. Du Pont No. 12, manufactured by E. I. Du Pont de Nemours & Co.
4. " No. 42, " " " " " " "
5. " No. 46, " " " " " " "
6. " No. 49, " " " " " " "
7. " No. 57, " " " " " " "
8. Sulphur, flowers.
9. Copper carbonate, pure.

In applying the dusts a small amount was shaken up with the seeds until they were coated. To avoid an excess of dust forceps were used to pick out the seed before planting.

Procedure: Six inch pots were used with fifty seeds sown in each. Three hundred seeds were used for most treatments, in both series, whereas four or five times as many check plants were run. The experiments consisted of three sets of one hundred seeds to each treatment for each series, inoculated and uninoculated. The pots were arranged on the greenhouse bench with the checks coming at intervals between the treatments, thus allowing for the influence of temperature variations. The greenhouse temperatures would average about 22 degrees Centigrade.

Data: In most cases the notes were taken two weeks after sowing. The emergence and seedling blight were recorded and from these an infection rate was determined. Non-emergence and seedling blight were given numerical values of 3 and 2 respectively, and from these the infection rate was expressed according to the formula used by McKinney *(17)*. Generally speaking the difference in infection rates for artificial inoculations and natural infections would indicate the influence of inoculations. Isolations were made of representative specimens from each series to give some assurance in the interpretations.

It is possible, when spores alone are used for inoculation, to apply some biological tests in order to arrive at a chemotherapeutical index as suggested by Riehm *(18)*, and later studied by Binz & Bausch *(1)*, Gassner *(7)* and others. At present it is difficult to apply such a method, especially when spore plus mycelial inoculum is used.

Greenhouse Experiments.

Experiment 1.

The protective influence of various seed treatments of wheat against infections from the soil and inoculations with *Fusarium culmorum*. The method of procedure has been explained under 'Methods'. Four of the solutions were tried in different strengths, the time of soaking was the same. The results are summarized in Table 1.

In the uninoculated series the checks showed an average emergence, some seedling blight and a fair infection rate. Those treated with formalin and sulphur were the only other ones to show some seedling blight. There appeared to be no advantage in increasing the strength of semesan, germisan, uspulun and tillantin solutions; in fact germisan and tillantin caused

TABLE 1. *Seed treatments of Marquis wheat in greehouse tests as a protection against artificial inoculations of Fusarium culmorum and natural infections from unsterilized soil.*

Treatment		No. of seeds sown	SOIL UNINOCULATED % Emerg.	% Sdl. blight	% Inf. rating	SOIL INOCULATED % Emerg.	% Sdl. blight	% Inf. rating
Check		1500	92.3	.06	7.7	62.6	4.4	40.5
Semesan	.3	300	95.3	0	4.5	94.6	0.3	5.6
"	1.0	200	94.5	0	5.5	99.0	0.5	1.3
"	2.0	200	96.0	0	4.0	95.5	1.0	5.2
Germisan	.3	300	92.6	0	7.4	90.6	0	9.4
"	1.0	300	94.0	0	6.0	96.6	0	3.4
"	2.0	300	86.3	0	13.7	87.3	0	12.7
Uspulun	.3	300	92.6	0	7.4	91.3	0	8.4
"	1.0	300	90.6	0	9.4	88.0	0	12.0
"	2.0	300	92.0	0	8.0	91.0	0	9.0
Tillanton	.3	300	84.0	0	16.0	85.6	0	14.0
"	1.0	300	90.3	0	9.7	94.6	0	5.4
"	2.0	300	88.0	0	12.0	86.3	.3	13.6
Segetan		300	95.6	0	4.4	95.6	0	3.4
Urania		300	96.3	0	3.7	94.0	0	6.0
Dupont	12	300	91.6	0	8.4	96.3	0	3.7
"	42	300	49.0	0	51.0	56.0	0	46.0
"	49	300	93.6	0	6.4	89.3	2.3	12.4
"	46	300	89.6	0	10.4	85.0	3.3	17.4
"	46	300	89.6	0	8.0	79.6	1.0	21.1
Sulphur		100	85.0	2	16.5	15.0	5.0	88.7
Formalin		100	78.0	2	23.5	6.0	2.0	95.5

TABLE 2.—*Seed treatments of Marquis wheat in greenhouse tests, as a protection against artificial inoculations of Helminthosporium sativum and natural infections from unsterilized soil.*

Treatment		No. of seeds sown	SOIL UNINOCULATED % Emerg.	% Sdl. blight	% Inf. rating	SOIL INOCULATED % Emerg.	% Sdl. blight	% Inf. rating
Check		1200	94.2	.3	6.0	36.8	6.2	67.3
Semesan		300	99.0	0	1.0	88.6	3.3	14.8
Germisan		300	95.0	0	5.0	87.3	5.3	16.9
Uspulun		300	96.6	.3	3.6	91.0	4.6	12.7
Tillantin		300	96.6	0	3.4	74.3	5.0	29.7
Formalin		300	73.6	.3	26.4	21.6	4.6	82.0
Segetan		300	82.3	1.0	18.5	64.6	6.3	40.4
Urania		300	88.3	0	11.7	82.3	6.3	22.7
DuPont	12	300	96.3	.3	3.9	87.0	7.3	18.8
DuPont	46	300	96.0	.6	4.4	60.6	7.6	45.4
DuPont	49	300	97.0	.3	3.2	41.0	8.0	55.4
DuPont	57	300	93.6	1.0	7.4	55.3	6.3	49.7
Sulphur dust		300	94.0	.3	6.2	10.6	5.0	93.4
Cu. Carb. dust		300	91.0	0	9.0	57.6	5.0	46.4

injury. In following tests 0.3 per cent solution was used. Semesan, germisan and uspulun at the ordinary strength gave some protection. Segetan, urania, Dupont No. 12 and No. 49 dusts, likewise offered some protection. Most of the remaining treatments caused a decrease in emergence, notably Dupont dust No. 42, sulphur and formalin.

In the inoculated series the checks revealed a fairly high rate of disease. Most of the injury was of the non-emergence type, although a fair amount of seedling blight was evident in some cases. Considering the disease rate, all the semesan solutions gave protection; germisan, uspulun and tillantin

were irregular; segetan, urania and Dupont No. 12 were very good while Dupont No. 42, sulphur and formalin cannot be considered satisfactory. (See Plate I, fig. 1).

Experiment 2.

The protective influence of various seed treatments of wheat against infections from the soil and inoculations with *H. sativum.* Thirteen treatments including solutions and dusts were tried in this experiment. The method of inoculation and note taking has been explained. The results are summarized in Table 2.

In the uninoculated soil it will be seen that the emergence of the checks could be considered normal. There was very little infection expressed as seedling blight shown in the large number of checks, but when non-emergence is considered a fair amount of natural infection is shown, and it is quite consistent. In comparing the infection rates semesan, uspulun, tillantin, Dupont No. 12 and No. 49 have a comparatively low infection rate. This is due to the increase in emergence. It is possible that these treatments protected the germinating seed from natural infections. Sulphur and copper carbonate did not offer any protection as compared with the checks. Formalin, segetan and urania either caused seed injury or exposed the germinating seed to infection, or both. (See Plate I, fig. 4).

In the inoculated series the checks with their high rate of infection show the success of the inoculation. When seedling blight is considered alone, the variation between the treatments and checks is not great. The variation in the percentage emergence is, however, very great and demonstrates the severe injury this fungus can cause in attacking the germinating seed. It also shows the protection offered by certain treatments during this stage. When the high rate of infection is considered, the control offered by semesan, uspulun, and Dupont No. 12 appear to be significant. On the other hand, formalin, segetan, Dupont No. 49, Dupont No. 57, sulphur and copper carbonate did not control under these severe conditions. Plants treated with formalin and sulphur reveal more disease than the checks. (See Plate 1, fig. 3).

Experiment 3:

Protective influence of various seed treatments of barley against infection from the soil and inoculations with *H. sativum.* This test is a duplicate of the previous experiment with wheat. The results are summarized in Table 3.

In the uninoculated series the checks gave an average emergence and express some disease. Formalin revealed the poorest emergence and most seedling blight. Semesan, germisan, uspulun, tillantin, urania, Dupont Nos. 46 and 57 gave the best protection. Formalin was very poor.

In the inoculations the checks showed a high rate of disease. Semesan, germisan, uspulun, tillantin, segetan, urania and Dupont No. 12 gave very satisfactory control. Dupont No. 57 and copper carbonate also showed some control. On the other hand sulphur and formalin were very unsatisfactory.

Table 3.—*Seed treatments of Hannchen barley in greenhouse tests as a protection against artificial inoculations of Helminthosporium sativum and natural infections from unsterilized soil.*

Treatment	No. of seeds sown	SOIL UNINOCULATED % Emerg.	% Sdl. blight	% Inf. rating	SOIL INOCULATED % Emerg.	% Sdl. blight	% Inf. rating
Check	1200	94.9	.4	5.3	54.3	5.3	49.2
Semesan	300	97.6	0	2.4	97.3	1.6	3.7
Germisan	300	98.3	0	1.7	96.9	2.6	4.7
Uspulun	300	99.3	0	.7	95.6	1.6	5.4
Tillantin	300	98.6	0	1.4	96.9	2.3	4.9
Formalin	300	87.3	1.6	13.9	38.9	5.6	65.5
Segetan	300	95.9	0	4.1	92.6	.9	8.1
Urania	300	98.3	0	1.7	97.9	.3	2.3
Dupont 12	300	95.3	0	4.7	97.0	.6	3.4
Dupont 46	300	97.3	.3	2.9	71.3	5.9	33.4
Dupont 49	300	95.3	.6	5.1	51.6	4.3	44.9
Dupont 57	300	98.0	0	2.0	89.6	4.3	13.8
Sulphur dust	300	93.0	.9	7.7	56.6	8.6	50.2
Cu. Carb. dust	300	96.6	.6	3.8	87.9	3.6	14.9

Experiment 4:

The protective influence of various seed treatments of oats against infection from the soil and inoculations with *F. culmorum.* Most of the treatments used for wheat and barley were used in this test. The results are summarized in Table 4.

Table 4.—*Seed treatments of Banner oats in greenhouse tests as a protection against artificial inoculations of Fusarium culmorum and natural infections from unsterilized soil.*

Treatment	No. of seeds sown	SOIL UNINOCULATED % Emerg.	% Sdl. blight	% Inf. rating	SOIL INOCULATED % Emerg.	% Sdl. blight	% Inf. rating
Check	1,200	84.6	1.2	16.2	50.9	3.3	51.3
Semesan	300	99.3	1.0	1.4	91.0	3.6	11.7
Germisan	300	97.6	.6	2.8	96.6	1.3	4.3
Uspulun	300	98.0	.6	2.5	92.0	2.3	9.7
Tillantin	300	94.6	2.0	6.8	98.3	.6	2.1
Segetan	300	99.0	.3	1.0	93.6	7.3	11.8
Urania	300	98.6	1.0	2.0	96.3	3.3	6.1
Dupont 12	300	99.3	0	.6	98.6	0	1.3
Dupont 49	300	85.3	0	14.6	58.3	10.6	83.0
Dupont 46	300	86.0	1.0	14.7	53.6	7.0	51.5
Dupont 57	300	91.6	1.3	9.3	75.3	7.0	29.9
Sulphur dust	300	77.6	1.3	26.3	40.3	5.6	63.9
Formalin	300	71.3	2.3	30.4	28.6	4.3	74.5

In the uninoculated series there is a lower emergence and as a consequence a higher disease rate than experienced with either wheat or barley. Oats appear to be particularly susceptible to injuries during the early stages of their development, and as a result if protection is offered by some treatment it is usually very evident. Semesan, germisan, uspulun, segetan, urania and Dupont No. 12 gave excellent protection, while tillantin and Dupont No. 57 were fair. As in the previous tests sulphur and formalin were not very satisfactory.

In the inoculations the checks show a high rate of disease. Germisan, tillantin, urania and Dupont No. 12 gave the best control. Uspulun, semesan and segetan gave good results, while Dupont No. 57 decreased the infection somewhat. The other treatments did not control and some, notably sulphur and formalin, reveal seed injury or predisposition. (See Plate I, fig. 2).

Miscellaneous treatments:

Some miscellaneous proprietary preparations, as well as some chemical compounds, were tested as possible seed treatments or stimulants. The test was conducted with wheat only, against inoculation of *Helminthosporium sativum*. None of the treatments gave satisfactory protection against inoculation, all showing a high rate of disease. Their influence on emergence may be considered. Chlorophol and Bayers dipdust in solutions of 0.3 per cent, and cupric jabonite, seed-o-san, nickel carbonate, nickel hydrate. Bayers dipdust, Bayers corn dust, Bayers special Nos. 1, 2 and 3 used as dusts did not cause a decrease in emergence. Dupont No. 42, however, caused severe seed injury. Sodium nitrate, potassium acid phosphate and sodium biphosphate were prepared in saturated solutions. The seed was soaked in these for 10 minutes, allowed to dry overnight and then sown. All of these, used in this manner, caused some seed injury. Commercial sulphuric acid, 1 part to 160 parts of water, seed soaked ½ hour, then dried, caused seed injury. Copper sulphide and copper oxide used as dusts did not cause seed injury, whereas arsenite used in the same way caused some seed injury.

Conclusions.

Greenhouse tests such as the above, where conditions are very favourable for disease development, should give some indication of the value of seed treatments against the fungi under consideration. Such tests serve to indicate the most promising ones for future field work. Our results indicate that such treatments as semesan, germisan, uspulun, Dupont No. 12, and some others to a lesser extent, gave a decided protection to the seedlings from attacks of these fungi. On the other hand, treating the seed with formalin or sulphur was very unsatisfactory. It is thought that it would be beneficial to use semesan, uspulun or Dupont No. 12 in the sowing of small seed lots for plant breeding material, small experimental plots, or in any case where each seed is of value.

Since some of the above treatments gave protection against natural infection from greenhouse soil, there is a possibility that this may have a practical application. Seed treatments which protect the seed from root and crown parasites may be useful in fields having persistent diseased patches. A small lot of seed sufficient for such infested areas could be treated, but recommendations in this direction must await further field tests.

While our results show that treatment with formalin did not offer any protection to oat seedlings against attacks from these fungi, it must be borne in mind that formalin is the best treatment for oat smut so far as is known.

Summary.

1. Greenhouse experiments were carried out to determine the value of seed treatments of cereals against natural soil infection and artificial inoculations with *Fusarium culmorum* (W. G. Smith) Sacc. and *Helminthosporium sativum* P.K. et B.

2. Five solution treatments (semesan, germisan, uspulun, tillantin and formalin) and nine dust treatments (segetan, urania, Dupont Nos. 12, 42. 46, 49, 57, sulphur and copper carbonate) were used.

3. Under the conditions of these experiments, semesan, germisan, uspulun and Dupont No. 12 showed a distinct protective influence to the seedlings from attacks of the fungi under consideration, as well as from natural soil infection, while formalin and sulphur were very unsatisfactory.

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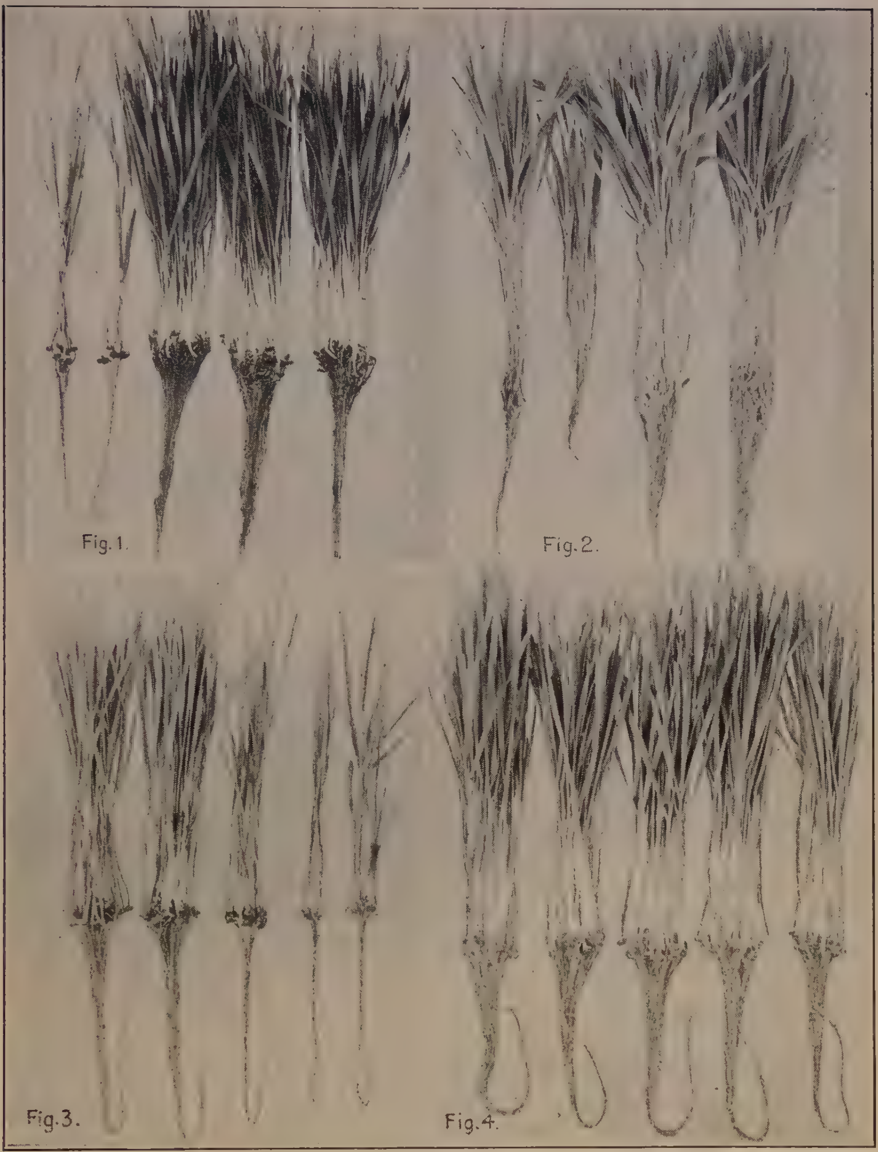

PLATE I.

FIGURE 1. Marquis wheat, showing the surviving seedlings from five pots sown with 50 seeds each and inoculated with *Fusarium culmorum*. The treatments were (left to right) check, formalin, semesan, segetan and Dupont No. 12.

FIGURE 2. Banner oats, showing the surviving seedlings from five pots sown with 50 seeds each and inoculated with *Fusarium culmorum*. The treatments were (left to right) check, formalin, semesan and Dupont No. 12.

FIGURE 3. Marquis wheat, showing the surviving seedlings from five pots sown with 50 seeds each and inoculated with *Helminthosporium sativum*. The treatments were (left to right) Dupont No. 12, germisan, check, sulphur and formalin.

FIGURE 4. Similar to fig. 3, with the exception that the soil was not inoculated.

PENTOSAN CONTENT IN RELATION TO WINTER HARDINESS IN THE APPLE.*†

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Introduction

Those regions in North America lying north of the 49th parallel of latitude in which the apple is successfully grown are relatively small in comparison with the areas in which this fruit has at best a precarious existence. Thus, throughout the whole of the Central Plains region of Canada the production of apples is restricted to a very few hardy varieties, mainly of Russian origin. There are also large sections of Eastern Canada, as well as considerable areas lying south of the international boundary in which the growth of the apple is similarly limited. This investigation was prompted by a consideration of these facts.

The literature in connection with the general subject of winter hardiness having recently been very thoroughly reviewed by a number of authors *(4, 7a, 22, 35)* reference will be made only to those studies directly related to the present work.

It is commonly agreed that dessication of the tissues is a very important primary factor in producing injury in plants as a result of exposure to low temperatures *(22, 31, 32, 33, 49a)*. In this respect winter injury in the apple, insofar at least as those forms due to disturbances affecting the woody tissue are concerned, appears to be no exception, the prevalent opinion being that loss of moisture is one of the most important factors concerned in injury to the roots and other woody portions of the tree. Nelson *(34)* and Shutt *(43)* have demonstrated that loss of moisture occurs from apple trees in winter§ while Sandsten *(41)* has presented data concerning the effect of climatic conditions upon water loss. The influence of dessication upon winter injury has very frequently been reported upon *(2, 7b, 7c, 13, 21, 30, 37, 48)*.

There are several factors which may be conceived of as regulating water loss from plant tissues. Thus, the concentration of the cell sap has been considered by many workers to exercise control over the amount of dessication taking place. However, the work of Chandler *(7b)* and Newton *(35)*, for example, indicates that there is no *general* correlation between the two phenomena. Differences in the physical structure of the tissues have also been suggested to play an important rôle in this respect. The fact that plant

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§ It has recently been shown (Hildreth, A.C., Minn. Tech. Bul. 42, 1926) that cold winter weather may have relatively little evaporating effect on twigs, and that apple twigs are able to withstand a considerable loss of moisture in winter without injury.

cells are of capillary dimensions is no doubt a factor, as D'Arsonval has pointed out *(1)*. It has also been noted by Wiegand *(49b)* that ice formation in the bud tissues of trees such as the elm, which are composed of large thin-walled cells, takes place at a *higher* temperature than in the corresponding tissues of trees in which these cells are smaller and possess thicker walls. Again, since ice formation takes place, mainly at least, in the intercellular spaces *(40)*, the structure and permeability of the cell wall must have an influence upon the dessication of the living material, the protoplasm of the cell.

Both the living and the non-living constituents of plant tissues are colloidal in nature and non-homogeneous. Unquestionably then, variations in the proportions of their components will affect their water-retaining power. MacDougal and his co-workers have demonstrated this effect in the case of artificial protein-pentosan complexes, and have shown that the amount of the latter constituent is very important. The pentosan or furfural-yielding complex is an important component of the secondarily-deposited cell wall material in plants *(6b, 45, 50)*. These materials are also considered by MacDougal *(28)* as being important constituents of the protoplasm, and the nucleus itself contains pentose groups as a part of the nucleic acid radical *(27)*. Again in the case of the succulent plants it has been shown *(29)* that under xerophytic conditions some of the hexose polysaccharides, which have a low imbibitional capacity, are converted into pentosans, which have a high capacity in this respect. It has long been recognized also that the mucilages and other characteristic pentose-containing materials possess a marked affinity for water, and notable swelling and imbibitional capacities. Finally, an actual correlation has been indicated to exist between pentosan content and water-retaining ability under the influence of frost in the case of such vegetables as the celery and cabbage *(39b)* and also in the case of apple twigs *(23)*. In the latter material Hooker has shown that apple tree tissues of varying pentosan content, as determined by the fermentation-copper reduction method of Spoehr *(44)*, have different capacities for the absorption and retention of water.

In view of the findings reported above it was considered advisable to investigate the relation of the pentosan content of certain varieties of apple of variable degrees of hardiness commonly grown in the orchards of Eastern Canada to the degree of frost resistance which they were known to exhibit. For the purposes of this study the term pentosan is taken to include practically any plant product yielding pentose sugars on hydrolysis, and as such, comprises such varied materials as the hemicelluloses, pectic substances, gums, mucilages, and even nucleo-proteins. The fact that all of these substances are colloidal, hydrophylic, and contain pentose groups is taken as justification for thus enlarging the scope of the definition, which is more usually restricted to materials of the hemicellulose type, the *principal* hydrolytic products of which are pentose sugars. An additional reason for including the other materials mentioned is, of course, the fact that the methods of estimation available do not permit of ready differentiation of

these different classes of compounds, nor of determining the amounts of pentose sugars originating from them.

Estimation of Pentosans

The literature on the estimation of pentosans having recently been reviewed by Pervier and Gortner *(36)* only a brief discussion from the critical standpoint will be attempted here.

The pentoses and pentosans yield furfural when heated with dilute mineral acids, and it is upon this reaction that most of the methods for the determination of these substances are based. The acid generally used is hydrochloric at a concentration of 12 per cent. When distilled in presence of this acid it is found *(5)* that arabinose and xylose give 75 and 90 per cent respectively of the theoretical yield of furfural. The amount of furfural produced under similar conditions from the methyl pentoses fucose and rhamnose has also been determined but, so far as the writer is aware, this relation is not known for ribose, the pentose sugar present in nucleic acid.

The furfural produced under the above conditions has been estimated in a considerable variety of ways. The earliest method, which was devised by Tollens *(45)*, involved precipitation as furfuramide. Other workers have converted the furfural to the corresponding phenylhydrazone, which was then estimated either by determination of the excess of phenylhydrazine remaining in the solution, or by filtering off the hydrazone and weighing it *(6a, 16)*. Councler *(9)* introduced precipitation with phloroglucinol, the precipitate being estimated gravimetrically. His procedure was later investigated, and improved and standardized, by Krober (25) and is at the present time the method officially recognized by the Association of Official Agricultural Chemists. Other precipitation methods which have been advocated involve the use of barbituric acid *(8)*, thiobarbituric acid *(11)*, and of sodium bisulphite *(24)*. Additional means of determination used have included reduction of Fehling's solution *(3, 15, 17)* and oxidation by means of bromine *(36, 38)*.

In addition to the chemical methods mentioned, procedures involving the use of biological agents have also been advanced. The essential steps in these methods are, hydrolysis, followed by removal of the hexose sugars by fermentation and estimation of the residual copper-reducing power. Such have recently been employed by Hooker *(23)*, Rosa *(39b)*, Spoehr *(44)*, and by Tottingham and Gerhardt *(47b)*.

In the application of any of the acid distillation procedures to pentoses, or to complexes containing these sugars, a number of sources of error must be taken into account, chief among which are the following:—

A. Substances other than pentoses yield furfural upon acid distillation *(5, 18, 42)*, among which may be mentioned the hexoses, sucrose, starch and cellulose. The error introduced by the presence of such materials is, however, probably small, being perhaps in the neighborhood of 0.5—1.0 per cent as a rule. The inclusion of such materials as glucuronic acid or other sugar acids of the same type such as occur in the pectic

substances and gums, however, may lead to very considerable increases in the amount of apparent pentose found.*

B. Other substances precipitable by phloroglucinol may be formed during the distillation process. Fraps (18) estimates that the error arising from this source may amount to as much as 7 to 23 per cent of the *crude* furfural found.

C. Again, even in the case of pure pentosan materials, the calculation of the furfural produced to a mixture in equal proportions of arabinose and xylose, as is usually done, when perhaps the material consists almost entirely of one or the other, would give rise to a very appreciable error as a result of the difference in the yields of furfural obtained from the two parent sugars.

D. Further, theoretical yields of furfural are not obtained *(5)*, and the actual yields are conditioned by the rate of distillation and the concentration of acid used *(6a, 20)*.

E. The phloroglucide obtained is appreciably soluble and solubility corrections are necessary *(26)*.

F. The composition of the furfural phloroglucide is indefinite. Goodwin and Tollens *(19)* claim that *one* molecule of water is split out in the condensation at ordinary temperatures, while Kröber *(25)*, in compiling the tables and formulae in general use for the conversion of furfural to terms of pentose or pentosan, assumed that *two* molecules are eliminated.

The first, third and fourth of the above criticisms of the acid distillation process apply with equal force to those methods proposing to estimate the furfural in the distillate by means of the amount of bromine or of copper reduced. Further, in the case of biological materials, the distillate will undoubtedly contain substances other than furfural which are capable of oxidation. Nor will fermentation of the distillate, or hydrolysate, ensure the removal of all such oxidizable materials.

Experimental

The material used in this investigation consisted of ten varieties of budded apple trees, together with seedlings from four other commercial varieties of apple and from two varieties of crabs. A wide range of hardiness was comprised in the selection. It was desired to compare the pentosan and moisture content of the apple tree top with that of the root, in view of the fact that the latter tissue often suffers considerable injury under conditions not seriously affecting the former. To that end an attempt was made to secure named varieties of trees of different degrees of hardiness which had been grown upon their own roots. This proving to be impossible the one year old seedlings were obtained as the best available substitute.

* Since the work reported in this paper was done Nanji, Paton and Ling have published a method which permits of at least an approximate estimation of the amount of uronic acids in plant materials (Cf. C. I. 44: 253-258T, 1925). Their procedure is based upon the fact that acids of this type give practically a theroetical yield of carbon dioxide upon decarboxylation by heating with sulphuric acid. Preliminary determinations of the uronic acid content of apple wood (alcohol-insoluble residue from one-year twigs) recently made by the writer indicate that the amount present is at least 12 per cent of the dry weight (at 100°C.). Since such acids yield about one-third of the theoretical amount of furfural, 12 per cent of uronic acids would correspond to about 4 per cent of the latter substance, or, according to Kröber's tables, 6.8 per cent of pentosan. Consequently, of the apparent pentosan found in the work reported above some 34 per cent may be assumed to have its origin in sugar acids of the glucuronic acid type..

These, as may be seen from Table 1, were all of either hardy or very hardy parentage, but it was considered that they would at least serve to show the relation usually obtaining between the aerial and subterranean parts of the apple tree in respect of pentosan and moisture content. This aspect of the relation of composition to hardiness has not received attention in any work which has come to the attention of the writer.

TABLE 1

Variety	Source	Age and Description of Tree	Cultural Treatment
Crimson Beauty Wagener Baldwin King of Tompkins Gravenstein	Annapolis Royal, N.S. " " " " " " " " " " " "	One year: budded on French stock.	Grown without cover crop and kept free from weeds throughout the season.
Hibernal seedlings Anis " Tetofsky " Duchess " Martha " Hyslop "	Ottawa, Ont., Canada " " " " " " " " " " " " " " "	One year seedlings of the varieties specified.	Grown without cover crop cultivation ceasing about mid-August.
Duchess McIntosh Red Wealthy Golden Russet Fameuse	Deschambault, Que., Can. " " " " " " " " " " " "	One year: budded on French stock.	Clean cultivation up to the end of August; then sown to rape.

Owing to the fact that the trees were of different ages and sizes the sampling of the material varied somewhat. The methods employed are outlined below. In the varieties from Nova Scotia five trees of each sort were taken and eighteen inches, measuring from the top downwards, removed from each. The material so obtained was called the "Top" sample. Six inch lengths were also taken from the basal portions of the trees, measuring from about two inches above the point of union of graft and scion upward. This constituted the "Base" sample. For the "Root" sample all *branch* roots of diameter between 0.5 and 1.0 cm. were taken. In the case of the seedling trees twelve of each parentage were taken, and, with this material the whole of the top portion of the tree was utilized in the preparation of the "Top" sample, while all of the roots larger than 0.5 cm. in diameter constituted the "Root" sample. The same procedure as in the case of the seedlings was followed with the one-year trees obtained from Deschambault, with the exception that five trees only of each variety were used. In this case also the "Root" sample included practically only the piece of root stock used in grafting since the new rootlets had rarely attained to a size of 0.5 cm. in diameter.

After sampling in the above manner the twigs and rootlets were cut into one inch lengths and split until the area of cross section was approximately the same in each. The samples from each variety were then thoroughly mixed and portions of an average weight of 50 to 70 grams were taken for determination of the rate of loss of moisture and pentosan content. After heating for thirty minutes at 90°C. to destroy the enzymes present and prevent possible changes in composition due to enzymatic action during drying the samples were heated at 75°C. to constant weight. It was considered that

constant weight had been attained when the loss in weight after consecutive periods of heating became of the order of 0.005 gm. and practically constant. The loss in weight after each two-hour period of heating was noted. Samples from the aerial portions of the trees reached constant weight after about 16 hours of drying at 75°C., while those from the roots required up to 30 hours.

Upon reaching constant weight the material was ground, first in a Krupp "Exzelsiormühle" grinder, and finally in a Dreef drug mill, to such a degree of fineness that it would pass a 1 mm. sieve. The ground wood was then spread out and allowed to come to equilibrium with atmospheric moisture at room temperature. It was then stored in closely stoppered bottles. When the samples were weighed out for the pentosan determination duplicates were also taken for moisture loss to constant weight at 100°C. The pentosan content was then calculated to this practically moisture-free and presumably uniform basis. The range in moisture loss at 100°C. was found to be small, namely, 5.40 to 6.65 per cent. The amount found present in the "Root" samples was, in the majority of cases, i.e., for 11 of the 16 varieties, slightly higher than that found in the corresponding "Top" samples.

Pentosan content was determined according to the procedure outlined in the Official Methods of the Association of Official Agricultural Chemists, except that 420 cc. of distillate instead of 360 cc. were collected. The results, together with those for moisture loss at 75°C., are given in Table 2. The figures for pentosan content are the average of two closely agreeing duplicate determinations.

When the results for pentosan content were compared with those of Hooker *(23)* it was noted that the amount found was much more considerable than that which he reported as being present from determinations made by the fermentation-copper reduction method. Thinking that this might be due to actual differences in the material rather than to variations inherent in the respective procedures followed, comparative determinations were made by each method on the same material. In addition, estimations were also made by the Pervier-Gortner method. The results are shown in Table 3, where they are compared with the pentosan content of apple wood as reported by Hooker *(23)* and Tottingham *(47a, 47b)*. For purposes of comparison all these results have been calculated to an air-dry basis.

In view of the large discrepancies between the results obtained by the use of the official HCl-phloroglucinol method as compared with those furnished by the fermentation-copper reduction method it appears, either that a considerable amount of pentose material is destroyed in the process of fermentation, or that very appreciable amounts of a substance or substances other than furfural precipitable by phloroglucinol are produced in the acid distillation of apple wood by the official method. It seemed probable that the increase might be due to the production of methylfurfural from methyl pentosans, or to hydroxymethylfurfural from hexoses or polysaccharides. The phloroglucides of the latter substances being soluble in alcohol whereas that of furfural is relatively insoluble, the precipitate obtained by the official

TABLE 2

Variety	Part of Tree	Per Cent Loss at 75°C.	Per Cent of Total Loss at 75°C. occurring at the 4th	8th	12th	20th Hrs.	Per cent Pentosan after Drying at 100°C
Crimson Beauty	Top	50.6	39.1	72.1	84.2	100.0	20.90
	Base	44.9	61.5	90.3	95.7	100.0	21.68
	Root	47.6	17.9	33.4	47.1	77.0	14.44
Wagener	Top	52.7	40.2	67.1	81.3	100.0	21.49
	Base	47.1	50.3	81.7	93.5	100.0	22.60
	Root	46.8	19.0	38.1	52.7	87.8	15.69
Baldwin	Top	57.2	44.0	68.4	83.3	100.0	19.76
	Base	50.7	52.9	83.7	94.8	100.0	20.85
	Root	51.0	32.3	58.9	80.7	98.5	16.77
King of Tompkins	Top	51.6	40.6	68.5	83.1	100.0	21.36
	Base	48.0	63.8	94.1	97.6	100.0	21.57
	Root	50.3	32.4	59.8	81.6	97.2	14.92
Gravenstein	Top	50.5	46.0	77.6	90.3	100.0	21.91
	Base	44.9	44.7	74.1	87.9	100.0	21.92
	Root	59.8	23.4	43.2	56.6	96.7	15.21
Hibernal Seedlings	Top	48.6	38.2	83.7	93.4	100.0	20.56
	Root	49.9	47.6	83.9	93.3	98.9	15.25
Anis Seedlings	Top	46.7	57.5	94.9	97.1	100.0	20.14
	Root	48.0	56.0	91.1	95.7	99.3	14.82
Tetofsky Seedlings	Top	68.6	71.8	95.8	97.5	100.0	20.42
	Root	49.2	42.1	78.7	91.1	98.5	14.94
Duchess Seedlings	Top	52.5	41.8	75.7	86.1	100.0	20.01
	Root	46.7	29.1	61.8	77.9	97.8	14.79
Martha Seedlings	Top	48.0	49.7	92.9	98.0	100.0	20.70
	Root	53.7	41.0	72.4	85.2	97.8	15.21
Hyslop Seedlings	Top	64.3	44.4	93.3	98.2	100.0	20.64
	Root	48.0	41.7	49.0	88.8	98.5	14.69
Duchess	Top	51.3	74.4	93.3	98.8	100.0	19.09
	Root	54.3	57.2	82.2	93.8	99.1	16.67
McIntosh Red	Top	52.2	53.6	78.0	92.9	100.0	20.81
	Root	57.7	49.4	74.1	92.4	99.0	15.30
Wealthy	Top	51.2	46.4	71.6	86.5	100.0	19.37
	Root	65.1	58.6	79.6	93.4	99.1	16.58
Golden Russet	Top	59.4	39.5	58.2	75.9	100.0	19.93
	Root	55.3	53.0	85.2	95.9	99.4	16.04
Fameuse	Top	57.8	40.7	69.8	88.6	100.0	20.28
	Root	61.2	51.3	75.7	93.0	99.3	17.81

TABLE 3

Analyst		PER CENT PENTOSAN IN APPLE WOOD A. By the Fermn. Method	B. By the HCl-Phloroglucin Method	C. By the Pervier-Gortner Br-Oxidn. Method
Hooker		5.26 to 8.10	----	----
Tottingham	1921	6.90	17.00	----
	1924	---	19.00	----
DeLong		8.50	19.16	23.38

method was in several cases extracted with alcohol in accordance with the procedure outlined by Schorger *(42)* for the determination of methyl pentosans. The alcohol-soluble fraction of the precipitate was found, however, to be equivalent to but 0.50 to 0.99 per cent of pentosan, whereas the official method indicated the presence of over 100 per cent more pentosan than

did the fermentation method.* The higher results given by the former procedure cannot therefore be accounted for on the basis of formation of methylfurfural or hydroxymethylfurfural during the process of distillation. It is concluded that the origin of the small amount of alcohol-soluble material found present was in the hexose substances rather than in methyl pentosans since the alcoholic extracts gave the color reactions indicated by Cunningham and Dorée as being characteristic of hydroxymethylfurfural. The fact that the results obtained by the Pervier-Gortner method were higher than those given by the official procedure may be explained as due to the presence in the distillate of substances oxidizable by bromine but not precipitable by phloroglucinol.

Discussion

In order to determine whether or not there is a correlation between pentosan content and hardiness in the varieties of apple studied, it is first necessary to arrange the latter as nearly as possible in the order of their resistance to frost injury. Several prominent horticulturists were consulted on this point and it was discovered that each of these authorities adopted an arrangement somewhat different from that considered correct by the others. Acordingly, the following method of obtaining a *definite* hardiness scale was adopted. The different varieties were first arranged in the order of hardiness as given by each of the authorities consulted. Each sort was then given a number ranging from one for the hardiest to fifteen for the least hardy variety in the list. The number assigned to a kind of tree thus gave an indication of its relative hardiness. These hardiness indices as given by the different lists were then totalled for each variety, and that sort receiving the *smallest* total was placed at the top of the corrected list as being the hardiest, the one receiving the next smallest next to it and so on. The list thus prepared is given below. It will be noted that Duchess and Martha, and also Wagener and Baldwin thus received the same rating.

1st—Hibernal
2nd—Anis
3rd—Tetofsky
4th—Duchess, Martha
5th—Hyslop
6th—Crimson Beauty
7th—McIntosh Red
8th—Wealthy
9th—Golden Russet
10th—Fameuse
11th—Wagener, Baldwin
12th—King of Tompkins
13th—Gravenstein

After arranging as above in order of hardiness it becomes possible to compare the relative hardiness with the pentosan content. This is done in Table 4.

* The question of the fermentability of the pentose sugars has been considered in detail by Abbott (Missouri Res. Bull. 85, 1926) since the work reported above was completed. In this paper it is shown that:—

One half of the yeasts and related organisms which were tested were able to destroy the five carbon sugar arabinose in a mineral solution under pure culture conditions.

Xylose and arabinose disappeared in solutions to which Fleischmann's yeast cake was added.

The fermentation method as commonly used for the determination of pentoses may be inaccurate because of (1) the presence of foreign organisms, (2) the fact that the common varieties of yeast such as are found in Fleischmann's yeast cake can utilize pentoses, and (3) the fact that galactose is as resistant to utilization by yeasts of Fleischmann's yeast cake as are the pentoses.

In view of the results reported by Abbott it would appear that the low figures obtained for pentosan content in the present study were very probably due to removal of pentoses by the yeast (Fleischmann's) employed in the fermentation process.

TABLE 4

Varieties in Order of Hardiness	Pentosan Content
Top Portion of Trees:	
Hibernal seedlings	20.56
Anis seedlings	20.14
Tetofsky seedlings	20.42
Duchess seedlings	20.01
Duchess (budded)	19.09
Martha seedlings	20.70
Hyslop seedlings	20.64
Crimson Beauty (budded)	20.90
McIntosh Red	20.81
Wealthy	19.37
Golden Russet	19.93
Fameuse	20.28
Wagener	21.49
Baldwin	19.76
King of Tompkins	21.36
Gravenstein	21.91
Roots of Trees:	
Hibernal seedlings	15.25
Anis seedlings	14.82
Tetofsky seedlings	14.94
Duchess seedlings	14.79
Martha seedlings	15.21
Hyslop seedlings	14.69

Inspection of Table 4 shows in a general way that the *least* hardy varieties tend to have the *highest* pentosan content, rather than the reverse as the pentosan theory of hardiness requires. Thus, in the ten budded varieties the average pentosan content of the five hardiest is found to be 20.02, while that of the remaining five sorts averages 20.96, nearly one per cent higher.

Respecting the relation between the moisture lost at 75°C. and the hardiness, an examination of the results presented in Table 1 fails to reveal any consistent correlation. For example, the Gravenstein, which is probably the least hardy of the named varieties examined, showed the *least* water loss at this temperature. On the other hand, the five hardiest of the named sorts had, on the average, lost more water at the eighth hour of drying than had the other five, the respective averages being 74.64 and 68.68 per cent of the total amount lost at 75°C. These results would indicate a positive correlation between the rate of water loss and pentosan content, but an *inverse* relation to hardiness. However, the fact that as a rule the top portions of the trees lost water *faster* than the roots—this holds true for twelve of the sixteen cases—in spite of the fact that the tops contained an average of 20 per cent pentosan while the roots contained an average of only about 15 per cent., indicates that the suggested correlation of rate of water loss to pentosan content is merely apparent. This conclusion is further supported by the fact that the total amount of water lost from the tops at 75°C. is greater than the total amount lost from the roots, the average amounts being 53.94 and 52.78 per cent respectively. Neither does it appear that this result can be due to the more tenacious retention of moisture by the tops than by the roots, since the latter lost water *more slowly* than did the former, as may be seen by examination of the data in Table 1.

Summary and Conclusions

Determinations of the content of so-called "pentosans" in the tops and roots of a number of named varieties of the apple of varying degrees of hardiness, and of seedlings from very hardy varieties of the apple and crab, have been made with a view to establishing a possible correlation between this fraction of the wood and the degree of hardiness of the varieties in question. The total loss of moisture at 75°C., and the rate of loss of moisture at that temperature have also been determined with a similar intent.

It has been shown that the *least* hardy varieties tend to have the *greatest* pentosan content as determined by the official HCl—phloroglucinol method, instead of the least as has previously been reported. There are marked inconsistencies, however, and it cannot be stated that any definite correlation has been found.

It does not appear that there is any positive correlation between pentosan content and total loss of moisture or rate of loss of moisture at 75°C. in either the aerial or subterranean portions of the apple tree. Thus, the top portions of the trees analyzed contained about 30 per cent more of the pentosan fraction than did the roots, yet the moisture loss from the two tissues was essentially the same in amount, averaging 52.78 per cent in the case of the latter and 53.94 per cent in the case of the former. Further, the tissues of the top portions of the trees lost water *faster* than did the root tissues in most cases, the former reaching constant weight in about sixteen hours, while the latter required twenty to thirty hours in most cases.

The literature on the determination of pentosans has been briefly reviewed, and the indefiniteness of the product measured in the different procedures, and the obscurity of its origin, indicated.

It has been shown that the discrepancy between results obtained by the HCl-phloroglucinol and fermentation-copper reduction methods is not due to any appreciable extent to substances precipitable by phloroglucinol and soluble in 95 per cent alcohol at 60°C.

It has been shown that the small alcohol-soluble fraction of the phloroglucide precipitate is probably derived from hexoses rather than from methyl pentosans since it gave color reactions characteristic of hydroxymethylfurfural.

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THE DEVELOPMENT OF THE WHEAT KERNEL

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In a paper read before the Western Canadian Society of Agronomy in December, 1920, and published in the February number (1921) of *Scientific Agriculture,* the writer gave particulars of some studies of the effects of premature harvesting on the wheat kernel. This work was done with Marquis wheat. The principal conclusions reached in that paper may be here summarized:

(1) When the rate of drying is very rapid (as in a building under hot, summer conditions) heads which have been cut with only three inches of straw attached give as heavy kernels as those where the straw is left long.

(2) During the development of the kernel, the rate of increase in weight was most rapid at about 17 days before the date of cutting, and then fell quickly until about 7 days before cutting. During the last week there was not much gain. If the central days of the period of most rapid increase in weight happen to be decidedly warm there will be an average daily gain of about two grammes in the weight of every 1,000 kernels, equal to about 100 pounds to the acre on a fairly good field.

(3) Determinations of protein by Dr. Frank T. Shutt, in the different samples showed (a) that protein was deposited throughout the whole period of development of the kernel, (b) that the rate of its deposition was most rapid at about the time when the kernel was gaining most rapidly in weight, and (c) that during the first few days of the experiment the deposition of other material was relatively more rapid than that of protein, so that the percentage of protein actually decreased. However, as the period of greatest physiological activity approached, the proportion of protein rose again. The percentage of protein did not change materially during the last ten days of the experiment.

While these results were fairly satisfactorily, it seemed desirable to repeat the experiment with some additional precautions.

Two varieties of wheat were chosen, Prelude and Marquis. The Marquis experiment will not be reported on, as, owing to the lodging of a large part of the plot, the gathering of uniform heads became very difficult and, besides, serious disease appeared.

On June 14th, 1921, more than 1,300 heads of Prelude wheat which showed at least one extruded anther and which were carried on straw of fair length, were marked as being at approximately the same stage of development. The marking was done by the simple plan of slipping over each head a circle of white cotton string about two and a quarter inches in diameter. Of course the string was not allowed to remain on the head, but dropped down and was usually caught by some of the leaves at a moderate distance from the ground. One person can mark about 400 heads in an hour.

It was planned to gather 120 heads on ten different occasions. The additional 100 or more heads marked allowed for some of the pieces of string becoming hidden. Only eight gatherings of heads were made as the continuous hot weather which occurred caused the wheat to ripen with unusual rapidity. The last sample gathered was almost perfectly hard.

The 120 heads were divided into three lots of 40 each which were treated as follows. From the first lot the kernels were removed the same day and were spread out (in a shallow, open cardboard box) to dry in a single layer under office conditions. The second lot had six inches of straw left attached to the heads. These were tied in a bundle and the bundle was suspended in the office from a cord, so that very good conditions for drying were provided. The third lot had its full length of straw attached, and was left out in the field to ripen under stook conditions (as nearly as possible). The precaution was taken to gather the heads always at the same time of day, between nine and ten in the morning. Obviously it would make a great difference on a very hot day whether the heads were gathered early in the morning or late in the afternoon. On each occasion, the heads were collected from every part of the area where the wheat was growing, and the utmost care was taken to reduce to a minimum the unavoidable error in sampling.

The following descriptions give details as to the appearance of the standing crop on each of the different dates when material was gathered, and also the appearance of the kernels and heads after becoming thoroughly dry.

It will be noted that rust attacked the wheat. The disease was, however, not very severe on Prelude and it does not appear likely that its presence made any serious difference from the normal in the development of the kernels.

June 27th. Lowest leaves are chiefly dried up; those just above are commencing to dry; most of the leaves are quite green. Stems commencing to turn yellowish at the base. Heads slightly yellowish-green. Some awns show a tendency to darken. (Prelude, ripened at Ottawa, usually has very dark awns). A few leaves show spots of rust. Kernels nearly full size, colour pale bluish-green; in the milk state.

When dry, the heads ripened indoors (with six inches of straw attached) were yellowish, tinged with green; straw pale bluish-green. The heads ripened outside (with full length of straw) were yellowish tinged with reddish; straw pale yellowish-green.

Comparison of the three lots of kernels after drying gave the following results. Those removed from the head on the day of harvesting are much shrivelled. About half are greenish, the remainder brownish, all rather pale, paler than the other two lots gathered on this date. Those ripened (indoors) with six inches of straw are much shrivelled; colour rather bright reddish-brown, very different from that of the kernels removed at once from the heads; no green kernels present. Those ripened in a stook in the field are much shrivelled; colour dull brownish; not so red as those with six inches of straw; very few kernels are greenish-brown.

June 29th. Appearance in the field essentially the same as on June 27th, but the stems are a trifle yellower towards the base; though they do not all show some yellow. Kernels pale yellowish-green; in the late milk state.

When dry, the heads ripened indoors were yellowish, slightly tinged with green; straw pale green. The heads ripened outside were yellowish, tinged with reddish. The straw was chiefly pale yellowish-green, occasionally yellow, with or without a slight greenish tinge.

The dry kernels show the following characters. Those removed at once from the heads are much shrivelled, rather pale. About half are greenish and half brownish: quite different from the other two lots gathered on this date. Those ripened with six inches of straw are much shrivelled; colour bright reddish-brown. Those ripened with full length straw are much shrivelled; colour rather dull brown, not so reddish as the lot with six inches of straw.

July 1st. Leaves withered at the base and withering about one-third of the way up from the base. Stems somewhat yellowish on the lower third. Heads yellowish-green. Awn turning yellowish and darkening at the same time. Rust on most leaves, but usually a few small spots only. No stem rust. Kernels yellowish-green; in the soft dough state.

When dry, the heads ripened indoors were yellowish, slightly tinged with green. Straw pale yellowish-green. The heads ripened in the field were yellowish tinged with reddish. Straw pale yellowish green, or sometimes more strongly tinged with green. On the whole, the straw of this sample appears greener than the corresponding lot gathered on June 29th.

The dry kernels show the following characters. Those removed at once from the heads are shrivelled; about one-third of them being greenish and the remainder brown in colour. Those ripened with six inches of straw are shrivelled; colour reddish-brown, very different from that of the kernels removed at once from the heads. Those ripened in the field are shrivelled; colour brown, a little less reddish than those dried indoors.

July 4th. Leaves withered half-way up the plants as a rule; sometimes all are withered. Stems sometimes yellowish at the base only, while others are yellow up to the head. One might say that on the average the stems are yellowish for two-thirds of the way up. Heads usually yellowish-green. Awns becoming distinctly darker in colour. Rust rather bad on nearly all leaves. No stem rust. Kernels pale yellowish-green; in the dough state, rather firm.

When dry, the heads ripened indoors were yellowish, but a few had a slight greenish tinge. Some of the straw was yellowish, but it was chiefly yellowish-green. Nearly all the awns were dark. The heads ripened in the stook were yellowish tinged with reddish. The straw was yellowish or sometimes greenish yellow.

The dry kernels show the following characters. Those removed from the heads at once are slightly shrivelled; colour brown with very rarely a slight greenish tinge. Those ripened with six inches of straw are slightly shrivelled; colour reddish-brown, brighter than that of the kernels removed at once from the heads and brighter also than that of the seeds ripened with

full length straw. Those ripened in the stook are slightly shrivelled; colour brown, duller than in kernels ripened with six inches of straw.

July 6th. Only the upper leaves remain not altogether withered. Straw yellowish-green to yellow. Heads yellowish-green to almost pure yellow. Awns brownish to almost black. Rust very bad on most of the leaves which are still green. No stem rust. Kernels pale yellowish-green; apparently larger than they will be when ripe; in the firm dough state.

When dry, the heads ripened indoors were yellowish (except for a few heads which were slightly tinged with green) with sometimes the very slight reddish tinge which is characteristic of Prelude wheat. Straw nearly always yellow, but occasionally yellowish-green. Awns varied in colour from slightly dark to almost black. The heads ripened in the stook were yellowish, tinged with reddish. Straw yellowish.

The ripe kernels show the following characters. Those removed at once from the heads are fairly plump; colour reddish-brown, almost the same as those ripened with six inches of straw. The kernels ripened with six inches of straw are fairly plump and of a reddish-brown colour. The kernels ripened in the stook are fairly plump; colour reddish-brown but not quite so bright as in the kernels ripened with six inches of straw.

July 8th. Only a few leaves remain unwithered. Nearly all stems and heads are yellow; the remainder are yellowish-green. Awns chiefly brownish or almost black. No stem rust. The kernels are pale yellowish in colour and appear of larger size than they will be when quite ripe. They are in the very firm dough state.

When dry, the heads ripened indoors were yellowish, tinged sometimes with a little reddish-brown. Awns usually somewhat dark. Straw yellow. The sample ripened in the stook was similar to the other.

The ripe kernels from the three different lots are practically identical; being of a reddish-brown colour and almost plump.

July 11th. Leaves practically all withered. Straw and heads yellow, only a few touches of green remaining in some cases. Kernels pale yellowish-brown to pale brown; very firm, but can be cut with the thumb nail.

When dry, the heads with six inches of straw were yellowish tinged with a little reddish-brown. Straw yellow. Awns usually somewhat dark. The sample ripened in the stook had yellowish heads tinged with reddish, and yellowish straw.

The ripe kernels from the three different lots seem identical, being of a reddish-brown colour and plump.

July 13th. Leaves all withered. Straw and heads yellow. Awns sometimes dark, but not always so. Kernels reddish-brown, hard, thresh out easily.

As the grain standing in the plot was practically ripe and hard on this date all the samples were essentially alike in appearance both when gathered and when examined later.

Weather Observations.

The following weather observations were made during the period when the samples were being collected. As the samples were gathered between

nine and ten in the morning, it seemed best to record, as the mean temperature for each date, the figure obtained by taking the average of the maximum of the preceding day and the minimum of the day in question.

Date	Minimum	Maximum	Mean	Remarks
June 27th	64.4	93.4	---	Decidedly humid; rain at night.
" 28th	66.0	87.6	79.7	Humid.
" 29th	65.0	83.4	76.3	Humid. About an inch of rain.
" 30th	63.0	81.6	73.2	Humid.
July 1st	64.4	84.0	73.0	Humid.
" 2nd	63.9	90.5	74.0	Humid.
" 3rd	70.8	94.0	80.6	Humid.
" 4th	69.9	96.5	82.0	Humid.
" 5th	66.0	83.8	81.2	Humid.
" 6th	66.9	92.0	75.3	Very humid.
" 7th	73.8	98.8	82.9	Humid.
" 8th	72.0	96.0	85.4	Humid.
" 9th	69.6	87.8	82.8	Humid.
" 10th	69.9	85.0	78.8	Humid.
" 11th	72.0	91.8	78.5	Very humid.
" 12th	70.0	91.4	80.9	Humid.
" 13th	72.5	99.6	81.9	Humidity moderate.

The adjoining table gives some details in regard to the samples. The weight of 1,000 kernels was determined from the full number of kernels on hand (more than 1,000 in every case) and precautions were taken to ensure uniform moisture content before the weighings were made. However, the quantity of moisture present in each sample was not ascertained.

The figures in the column headed "Protein" are taken from the Report of the Dominion Chemist, Dr. Frank T. Shutt, for the year ending March 31st, 1922. These determinations were kindly made by Dr. Shutt at the writer's request. They corroborate those of the previous investigation referred to at the beginning of this paper.

The columns showing the gain (or loss) in weight of 1,000 kernels, by allowing them to ripen in the head with either six inches of straw or with full length straw, contain irregularities which seem impossible of plausible explanation except by supposing that rather considerable experimental errors occurred. The writer took all the precautions he could think of to make the sampling in the field uniform. Possibly the samples of threshed grain were not stored long enough under suitable conditions to secure uniformity of moisture content before being weighed.

The extreme heat throughout the whole time of the experiment, and the fact that Prelude is naturally a quick maturing wheat account for the figures which show that the loss of crop due to cutting a few days before the date of full maturity would have been from 2½ to 3½ per cent. Under ordinary conditions this loss would probably be much smaller for so short a time.

The average daily gain in weight of the kernels in the standing crop was ascertained from the weight of 1,000 kernels removed at once from the heads.

June 27th to 29th	the average daily gain in weight of 1000 kernels was		2.106 g.
" 29th " July 1st	" " "		1.707 g.
July 1st " " 4th	" " "		2.006 g.
" 4th " " 6th	" " "		1.350 g.
" 6th " " 8th	" " "		1.416 g.
" 8th " " 11th	" " "		.162 g.
" 11th " " 13th	" " "	(loss)	.157 g.

Date when gathered	How treated	Weight of 1000 kernels in grammes (after thorough drying)	Gain in weight of 1000 kernels after cutting taking the kernels removed at once as the basis		Percentage of full crop obtained	Protein (calculated to dry matter basis) per cent
			Heads left with six inches of straw	Full length straw		
June 27th	Seeds removed at once.	11.626	----	----		18.64
" "	Ripened with 6 inches of straw.	11.739	.113	----		18.70
" "	Ripened with full length straw.	13.382	----	1.756	42.7	19.73
	(Average)	12.249				
June 29th	Seeds removed at once.	15.839	----	----		17.24
" "	Ripened with 6 inches of straw.	15.596	(loss) .243	----		18.43
" "	Ripened with full length straw.	18.607	----	2.768	59.4	19.48
	(Average)	16.681				
July 1st	Seeds removed at once.	19.253	----	----		17.26
" "	Ripened with 6 inches of straw.	19.118	(loss) .135	----		17.31
" "	Ripened with full length straw.	20.212	----	.959	64.5	18.25
	(Average)	19.528				
July 4th	Seeds removed at once.	25.272	----	----		18.07
" "	Ripened with 6 inches of straw.	25.707	.435	----		18.40
" "	Ripened with full length straw.	25.740	----	.468	82.2	18.88
	(Average)	25.573				
July 6th	Seeds removed at once.	27.972	----	----		18.64
" "	Ripened with 6 inches of straw.	28.653	.681	----		18.80
" "	Ripened with full length straw.	29.449	----	1.477	93.9	18.80
	(Average)	28.691				
July 8th	Seeds removed at once.	30.804	----	----		19.28
" "	Ripened with 6 inches of straw.	30.907	.103	----		19.07
" "	Ripened with full length straw.	30.238	----	(loss) .566	96.5	19.21
	(Average)	30.650				
July 11th	Seeds removed at once.	31.290	----	----		19.58
" "	Ripened with 6 inches of straw.	31.370	.080	----		19.00
" "	Ripened with full length straw.	30.541	----	(loss) .749	97.4	19.38
	(Average)	31.067				
July 13th	Seeds removed at once.	30.975	----	----		19.51
" "	Ripened with 6 inches of straw.	31.110	.135	----		19.53
" "	Ripened with full lenths straw.	31.349	----	.374	100.0	19.70
	(Average)	31.145				

These figures should be more accurate, as showing what actually occurs day by day, than any determinations based on the weight of kernels which have been allowed to ripen in the heads, after the grain has been cut. The negative result obtained with the last sample is difficult to explain.

In the diagram on page 531 are plotted the mean daily temperature, the daily gain in weight of 1,000 kernels and the weight of 1,000 kernels. In these cases the figures obtained for the kernels removed at once from the heads have been used.

The broken lines show the curves which would probably have been obtained had the mean daily temperature remained constant.

The maximum daily gain of over 2 grammes in the weight of 1,000 kernels is a little greater than that previously observed in Marquis wheat. High temperature and the naturally more rapid development of Prelude wheat account for this difference.

It is to be noted that, on the whole, the observations recorded in this paper agree well with those previously made, under somewhat different conditions, on Marquis wheat. They furnish a needed confirmation of the earlier work. Further experiments should be done on this interesting question as to what takes place during the development of the wheat kernel, particularly with a view to eliminating all irregularities in the observations and finding the explanation of the relatively high weight (occasionally observed) of the kernels removed at once from the heads.

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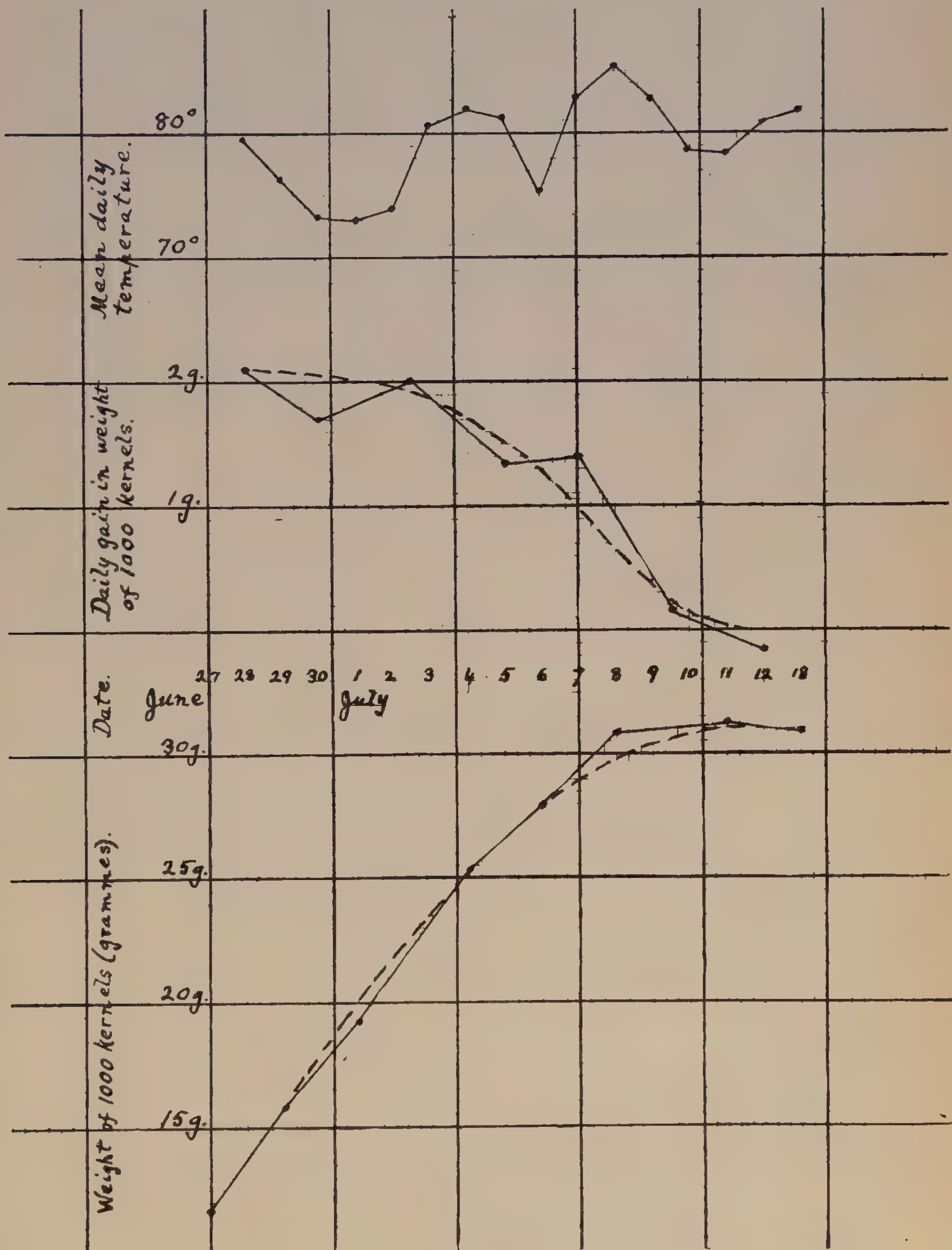
80°
70°
Mean daily temperature.
2g.
1g.
Daily gain in weight of 1000 kernels.
27 28 29 30 1 2 3 4 5 6 7 8 9 10 11 12 13
June
July
Date.
30g.
25g.
20g.
15g.
Weight of 1000 kernels (grammes).

GEOLOGIE ET RESSOURCES AGRAIRES*

H. M. Nagant

Nous avons bien des fois l'occasion de lire des articles de journaux et de revues, d'ordre économique ou social, dans lesquels il est question de la population de la province de Quebec, de la désertion des campagnes et de l'émigration vers les grandes villes ou les Etats-Unis, et de tous les maux qui en sont le corollaire.

Il n'est pas rare non plus de trouver parmi les considérations émises à propos de ces graves sujets, des raisonnements du genre suivant:

"La province de Québec possède un territoire plus vaste que celui de l'Angleterre, de la France et de l'Italie réunies, elle devrait donc pouvoir fournir la subsistance à vingt ou trente millions d'habitants et davantage, puisque ces nombres ne représentent pas même la population d'un seul des trois pays susnommés. Emparons nous donc du sol! Dirigeons nos jeunes gens des vieilles paroisses vers les terre neuves! Inculquons leur le courage et la persévérance de nos pères qui défrichèrent la vallée du St. Laurent, faisons reculer la forêt au profit de l'agriculture!"

Et, devant la constatation que nos immenses forêts ne se changent pas en régions de colonisation, certaines personnes sont facilement portées à en jeter la responsibilité sur les autorités, qui sacrifieraient un peu les intérêts de la colonisation à ceux de l'exploitation forestière, en concédant la territoire non exploité encore de la province plutôt au puissant marchand de bois qu'au faible colon.

On voudra bien nous croire si nous affirmons que nous n'avons pas l'intention de nous poser en défenseur de l'un ou l'autre gouvernement, ni d'affirmer que tout soit pour le mieux dans les lois et règlements des départements des Terres et Forêts ou de la Colonisation de notre province; notre intention est tout simplement de relever certains raisonnements simplistes, rencontrés assez communément dans les discours et écrits de bien des sociologues, économistes et colonisateurs d'occasion, lesquels témoignent d'une singulière négligence des principes de la géologie en général et de la géographie physique et économique en particulier, de notre territoire.

Ceux qui tirent ces conclusions plutôt audacieuses de l'équivalence de surface entre la province de Québec et trois pays des plus populeux de l'Europe occidentale font bien quelques réserves quant aux différences climatériques entre les régions comparées; ils se rendent immédiatement compte, en effet, qu'une bonne moitié au moins, de l'étendue de la province de Québec, comprenant notamment tout ce territoire de l'Ungava, se trouve à une latitude où la basse température moyenne constitue à priori un obstacle à toute colonisation agricole, mais ils semblent se soucier bien peu du facteur géologique pour la moitié restante et pensent être réellement modérés en estimant ses possibilités de peuplement à une vingtaine ou une trentaine de millions d'individus, nombre toujours inférieur à celui nourri par une sur-

* Texte d'une conférence faite devant la Société d'histoire naturelle de l'Université de Montréal.

face plus petite correspondant à l'un des trois pays amenés dans la comparaison.

Et pourtant, un parfait étranger, n'ayant même jamais mis le pied au Canada, mais qui posséderait de solides notions fondamentales de géologie et se donnerait la peine d'examiner attentivement la carte géologique de la province, déployée sur sa table de travail, tout en se guidant d'une brève description physiographique, ne tomberait jamais dans des exagérations aussi manifestes, s'il avait à donner une appréciation sur les possibilités de culture et de colonisation futures de notre territoire.

D'un premier coup d'œil, il jugerait que, quelque magnifiques que puissent être les ressources naturelles encore latentes de la province de Québec et brillantes les perspectives de leur mise en valeur, les possibilités agricoles en sont assez limitées, si on veut bien les comparer à son immense étendue. Sans avoir à consulter, le rapports détaillés ou de données statistiques, bourrées de chiffres, notre explorateur n'aura pas même besoin de faire un voyage autour de sa chambre, comme Xavier de Maistre, pour se rendre compte que quelques pour-cent à peine de la surface totale de la province de Québec sont susceptibles d'être exploités avantageusement par l'agriculture, et que tout le reste ne peut pas étendre ses prétentions au-de-là du domaine de la sylviculture, et à condition encore que celle-ci ne soit pas compromise par une exploitation inconsidérée, qui peut ruiner les perspectives d'une production régulière de la matière ligneuse.

Au premier coup d'oeil, en effet, il sera bien obligé de constater que nous jouissons de l'honneur plutôt onéreux de faire partie intégrante du plus ancien continent du monde, usé jusque dans ses bases et n'ayant reçu, sur le tard, qu'un léger fard de sédiments quaternaires couvrant une minime partie de sa surface, pour réparer des ans ou plutôt des milliers de siècles l'irréparable outrage.

Cantinuant son examen, il verra que la superficie de la province de Québec se divise tout naturellement en trois provinces géologiques bien distinctes, mais fort inégales en étendue, qui sont:

Le Grand Plateau Laurentien

Ne représente lui-même que la branche orientale de l'immense fer à cheval entourant la baie d'Hudson, qu'un célèbre géologue autrichien, Ed. Suess, décora de la pittoresque appellation de "Bouclier Canadien", dont la saveur expressive fit fortune même en dehors de la littérature géographique.

Illustrons au moyen d'une petite comparaison ce que représente le Plateau Laurentien par rapport au continent originel dont il dérive, en supposant qu'un ouragan d'une violence inouie, soufflant à une vitesse de plusieurs centaines de milles à l'heure, se déchaine sur la ville de Montréal et balaie toute la superstructure des édifices pour en précipiter les débris dans le fleuve qui coule majestueusement au sud-est de la ville. Le Néo-Zélandais que Macauley fait assoir sur un pilier ruiné du pont de la tour de Londres, d'où il contemple les restes de la grande cité, pourrait bien aussi avoir la fantaisie de venir explorer ce qui reste de Montréal après le cataclysme de haute hypothèse. Eh bien! qu'est-ce qui, alors, révèlerait immédiatement que des

édifices de dix ou de quinze étages s'élevèrent jadis à 100 ou 200 pieds du niveau du sol qu'il foule? Ne seraient-ce les massifs blocs de béton marquant les fondations d'un élévateur à grain, d'un hôtel Mont Royal ou de quelque autre construction comparable en importance et hauteur.

Il en est à peu près de même pour le Plateau Laurentien, lorsque nous le parcourons aujourd'hui. Partout nous ne rencontrons que roches massives, profondément métamorphisées, le plus souvent entièrement cristallines, telles que des roches granitiques ou plutoniennes, dont les structure et texture indiquent une solidification à grande profondeur, du gneiss de différente nature, des quartzites, des calcaires cristallins etc., qui fournissent la preuve évidente que sur la pénéplaine actuelle devaient s'étager jadis des milliers de pieds de roches, sédimentaires ou éruptives, qui furent balayées dans les bassins marins qui l'entouraient.

La seule différence, c'est qu'au lieu d'un cataclysme comme celui que nous avons supposé pour la ville de Montréal, on a eu affaire à l'érosion infinement lente, mais combien continue, de milliers de siècles, qui a amené, parcelle par parcelle, l'ablation de toute la superstructure d'un continent, jusque dans ses fondations les plus profondes, pétries, laminées, et refondues sous les prodigieuses pressions et températures engendrées par le poids énorme des masses qu'elles supportaient.

Nous savons aussi que la glaciation, incident qui dans la chronologie des évènements géologiques ne date que de hier, donna les derniers coups de rabot et de lime au Plateau Laurentien, dont la topographie générale ne devait pas être beaucoup différente de celle qu'elles offre aujourd'hui, au début de l'ère Pléistocène ou Quaternaire.

L'inlandsis," ou calotte glaciaire dont le centre principal de rayonnement est supposé avoir été en plein milieu de la péninsule du Labrador remplit à peu près l'office d'un polissoir, comme ceux employés dans les glaceries pour réduire les grandes plaques de verre brut en glaces unies, atténuant toutes les protubérances de la pénéplaine laurentienne, au cours de leur lente progression dans une direction générale sud-ouest. Les nappes successives en convertirent les aspérités relativement peu considérables en une succession ininterrompue de roches moutonnées ou croupes arrondies, séparées les unes des autres par des cuvettes d'érosion qui, la période glaciaire terminée formèrent les innombrables lacs donnant au paysage laurentien un autre caractère bien typique.

Aux lacs provenant du surcreusement des cuvettes et vallées sont encore venus s'ajouter ceux, très nombreux aussi, qui prirent naissance à la suite des barrages morainiques jetés en travers des vallées rocheuses, lors de la régression des lobes glaciaires qui s'y étaient engagées.

Bref, ce que nous voulons faire ressortir, c'est que la placide et lente glaciation ne se soucia guère de l'intérèt des futurs agriculteurs dans son travail de finissage sur toute l'étendue de la pénéplaine laurentienne. Lorsque, son oeuvre terminée, elle se retira, en apparence définitivement, dans les régions arctiques du continent et sur le Groënland, les bosses du Plateau Laurentien durent apparaître nues comme des crânes dépouillés, réfléchissant la lumière par la surface polie de leurs roches cristallines.

Sur les flancs peu inclinés de ces collines et dans les dépressions, il devait y avoir des dépôts morainiques abandonnés par les lobes glaciaires aux diverses étapes de leur régression; ils furent affouillés par les eaux courantes issues du front glaciaire, dévalant des pentes aux époques de ruissellement, et débarrassés de tous les matériaux les moins grossiers, entrainés dans les dépressions lacustres ou dans le bassins marins entourant la pénéplaine. Seuls restèrent en place, des blocs erratiques, des amas de gros cailloux et les cônes de déjection de graviers grossiers, déposés par les cours d'eau torrentiels.

La dernière période glaciaire est de date trop récente encore pour que les surfaces de roches cristallines rafraîchies par le rabotement aient eu le temps de subir une altération appréciable sous l'influence des agents atmosphériques et de se convertir en terre meuble par désagrégation.

Une forêt finit par recouvrir tout cela, mais ce ne dut être qu'à la suite d'un laborieux travail de conquête, avec les lichens, les mousses et autres végétaux cryptogamiques, comme pionniers d'avant garde; ceux-ci étendirent par plaques un premier et mince feutrage de matière organique végétale retenant l'humidité à la surface des roches moutonnées ce qui permit la germination des graines des premières essences forestières. Les racines de ces plantes ligneuses, s'insinuant dans les moindres fissures, furent les crampons destinés à fixer le tapis d'humus né de l'accumulation des feuilles et des tiges mortes, sur les roches inhospitalières, maintenant recouvertes d'un manteau continu mais combien fragile et éphémère dès que l'exploitation inconsidérée, presque toujours accompagnée d'incendies qui en accentuent trop l'effet désastreux, fait disparaître la forêt.

Une conclusion se dégage donc tout de suite d'un premier examen de la carte géologique: c'est que la province physiographique qui embrasse la pénéplaine laurentienne et représente environ 93% de la superficie totale du Québec, est et devrait rester un domaine forestier dans son ensemble.

L'agriculture fait une oeuvre malfaisante au point de vue de l'avenir économique du pays, en essayant d'en faire la conquête. En effet, le défrichement de la forêt ne tarde pas à entrainer la ruine complète et définitive de ces terrains qui ne peuvent procurer aux colons que les avantages transitoires de la coupe du bois et des quelques récoltes précédant la destruction finale du fond.

La forêt une fois disparue, le tapis d'humus se dessèche sous l'ardeur du soleil, se désagrège et se consume rapidement sous l'effet de l'aération qu'amène le travail du sol. Par suite, la faible proportion de constituants minéraux du sol perd toute cohésion et ne tarde pas à être entrainée dans les "thalwegs", par le ruissellement suivant les grosses averses et la fonte des neiges. Il ne reste plus alors que les surfaces rocheuses polies et les bloes erratiques, dont la reprise de possssion par la végétation forestière, naturellement ou par des moyens artificiels, est devenue pratiquement impossible. D'autre part, les terrasses de graviers et de sables grossiers, produites surtout de la trituration de gneiss siliceux, sont si pauvres en constituants minéraux utiles qu'ils deviennent presque sans valeur dès que la couche humifère qu'ils portent s'est volatilisée.

L'examen un peu plus minutieux de la carte géologique du Plateau Laurentien nous révèle cependant que, vers la fin de la glaciation, une circonstance amenda les conditions générales si défavorables à toute perspective agricole dans la partie centrale du Bouclier Canadien. Ce fut la formation des lacs glaciaires temporaires, peu profonds mais très étendus, qui prirent surtout naissance entre le front de la nappe labradoréenne, reculant vers le nord et la ligne de faîte séparant le bassin hydrographique du St. Laurent de celui de la baie d'Hudson.

Un des plus remarquables de ces lacs temporaires est connu sous le nom de lac Ojibway. Lorsque le barrage glaciaire s'éclipsa définitivement pour prendre ses quartiers dans les régions boréales, les nappes d'eau qu'il avait retenues se vidèrent naturellement dans la baie d'Hudson et ne laissèrent que des reliquats dans les parties basses de la plaine limoneuse en état d'émergence, représentés par le lac Abitibi actuel et une foule d'autres lacs ou mares moins considérables. L'Ojibway eut une existence assez longue pour que des masses considérables de sédiments eussent le temps de se déposer en couches bien stratifiées, suivant le processus naturel, graviers et sables sur les terres les moins profondément immergées de la zone périphérique, les argiles dans la partie centrale plus profonde.

Il faut observer d'ailleurs que cette zone d'argile de l'Abitibi s'étend sans interruption à travers la ligne de partage actuelle des eaux, très peu marquée toutefois, dans la région du lac Témiscamingue, qui, lui, n'est qu'une profonde fosse tectonique à travers laquelle s'écoule l'Ottawa. D'après M. E. Wilson, cette partie du manteau d'argile non recouverte par le lac Ojibway se serait déposée dans un autre lac, antérieur au premier, auquel il propose de donner le nom de lac Barlow, et qu'on suppose avoir été formé à la suite du barrage de la fosse du Témiscamingue ou de l'Ottawa dans sa partie inférieure, par le lobe ontarien detaché de la nappe glaciaire labradoréenne.

Les terres de l'Abitibi et du Témiscamingue ne représentent d'ailleurs que la portion orientale de la grande nappe alluvionnaire, connue sous le nom de Clay Belt, dont la majeure partie s'étend dans le nord de l'Ontario et occupe une superficie totale estimée à 68,000 milles carrés.

Il faut faire remarquer, en outre, qu'une partie de celle-ci est attribuée à des alluvions marines formées à une époque de transgression des eaux de la baie d'Hudson, voisine de celle de l'existence des lacs glaciaires. Des plages modernes et des plaines d'argile marine qui sont aujourd'hui au-dessus de la mer l'indiquent dans les terres basses de la *Clay Belt* qui entourent la Baie d'Hudson.

Il y aurait encore à tenir compte de la région très bonne au point de vue agricole, d'alluvions en majeure partie argileuses entourant le lac St. Jean, lequel marque aussi un affaissement en forme de cuve, caractérisé par la présence de sédiments Ordoviciens (Trenton et Utica), dans la partie orientale de la pénéplaine précambrienne. Mais, par suite de la parenté d'origine attribuée souvent aux alluvions du lac St. Jean avec ceux de la plaine du St. Laurent déposées dans la mer de l'époque Champlain, nous les considérerons plutôt comme formant un appendice de la plaine Laurentienne. Plusieurs

àuteurs pensent, en effet, que la bassin du lac St. Jean ne forma qu'une baie de la mer Champlain lorsque celle-ci submergea la vallée du St. Laurent, toujours vers la fin de l'époque Pléistocène, caractérisée par des affaissements généraux.

Region Appalachienne

Un coup d'oeil jeté à l'est de la carte géologique de la province nous fait découvrir une deuxième région physiographique qui se développe à peu près au sud-est d'une ligne partant du lac Champlain pour se diriger tout droit vers la ville de Québec et suivre ensuite la rive sud du fleuve St. Laurent ou, plus exactement, le pied des hauteurs qui s'étendent en bordure de cette rive, depuis Lévis jusque dans le golfe. Il est facile de se rendre compte que cette deuxième région forme aussi partie d'un système montagneux très ancien, celui des Appalaches, aux assises fortement refoulées, plissées et rejetées, envahies à plusieurs reprises par des masses considérables de roches éruptives. Les cartes géologiques de la province nous apprennent, en effet, que la région Appalichienne du Québec est caractérisée par les multiples plissements des couches d'âge paléozoique, sous l'influence des formidables poussées orogéniques venues de l'est, qui se manifestèrent à plusieurs reprises et notamment vers la fin des périodes Ordovicienne (révolution taconique) et Dévonienne (révolution appalachienne).

Chaque phase de soulèvement et de plissement fut suivie d'une période d'érosion intense ramenant le système montagneux des Appalaches à l'état de pénéplaine, de sorte que les roches cristallines du fondement précambrien furent mises à nu suivant les axes de certains anticlinaux, après l'arasement de ceux-ci.

Vers la fin de l'ère Secondaire ou le commencement du Tertiaire, un autre soulèvement continental, d'un amplitude d'une couple de milliers de pieds, détermina une nouvelle période de dénudation. C'est à ce dernier cycle d'érosion que nous devons en grande partie la topographie diversifiée des hauteurs d'aujourd'hui. Enfin, comme le Plateau Laurentien, les hauteurs Appalachiennes subirent une dernière atténuation du fait de la glaciation de l'ère Quaternaire.

Les terrains de cette province géologique sont donc très variés et l'étude en est extrêmement compliquée; les formations sédimentaires les plus anciennes et les plus récentes de la province de Québec y voisinent avec des roches ignées très variées qui les ont envahies à diverses époques.

Dans la partie sud-est de la province on rencontre surtout des subdivisions du Cambrien et de l'Ordovicien; dans la Gaspésie prédominent les formations Siluriennes et Dévoniennes, avec quelques lambeaux du Carbonifèrien inférieur qui représentent les terrains les plus récents de notre vieux territoire.

En résumé donc, la région des Appalaches est aussi essentiellement un vieux massif montagneux ayant subi à l'époque Quaternairne, comme le Plateau Laurentien, mais à un moindre degré cependant, les effets de la glaciation. D'autre part, les roches sédimentaires paléozoiques qui prédominent dans cette région: schistes, grès, calcaires, sont rarement métamorphisées

et cristallines et par conséquent plus facilement transformables en matériaux meubles sous l'action mécanique et chimique des agents atmosphériques. Il en résulte qu'aux dépôts glaciaires ou aux produits de leur remaniement par les eaux courantes, on trouvera associée une plus forte proportion de sol résiduel formé sur place qu'à la surface du Plateau Laurentien. Aussi C. A. Young. (Esquisse géologique du Canada), remarque ce qui suit: "Malgré son caractère montagneux, accidenté et souvent rude, la région Appalachienne renferme des districts fertiles et bien cultivés, parmi lesquels on peut citer les Cantons de l'Est de la province de Québec.

Cependant la majeure partie de cette province géologique représente encore une fois un district forestier plutôt qu'une région se prêtant à l'exploitation agricole; ceci est vrai notamment pour la Gaspésie, dont le relief trop accentué n'offre de perspectives pour l'agriculture que dans la vallée de la Matapédia, les versants de la Baie des Chaleurs et quelques anciens deltas ou étroites terrasses à l'embouchure des rivières.

La Plaine du St. Laurent

Le caractère entièrement différent des deux autres provinces physiographiques ressort immédiatement de l'examen de la Plaine du St. Laurent, région trop petite hélas! qui, sur la carte, se détache assez nettement sous forme d'un triangle dont les sommets seraient figurés par les villes d'Ottawa et de Québec, et lac Champlain.

Elle ne représente d'ailleurs qu'une subdivision de la région naturelle connue sous le nom de région des Basses-Terres du St. Laurent, dont les autres parties occupent l'Ontario oriental et la Péninsule de Niagara. La région entière n'atteint qu'une superficie de 35,000 milles carrés, de sorte que la partie québecqoise n'occupe qu'une bien faible portion de la surface totale de la province.

Cette Plaine du St. Laurent est limitée au nord par le bord sud-est du Plateau Laurentien, qui suit une ligne assez droite d'Ottawa à Québec; au sud-est elle confine à la grande ligne de fracture qui va du pied du lac Champlain vers la ville de Québec pour se confondre ensuite avec le lit du St Laurent jusque dans le Golfe. Cette faille sépare nettement les assises paléozoiques restées relativement horizontales qui forment le fondement de la Plaine du St Laurent, des couches bouleversées de la Région des Appalaches. Au-delà de Québec, la Plaine Laurentienne ne se prolonge que sous forme d'une étroite corniche en bordure de chaque rive du fleuve.

Il est probable que bien peu de cultivateurs de cette région se doutent de l'action providentielle qu'exerça pour eux la fameuse faille Champlain St Laurent. Cette grande cassure survenue dans les couches paléozoiques, sur une longueur controlée de 900 milles, lorsqu'elles furent refoulées contre la Plateau Laurentien, empècha, en effet, les plissements de se transmettre plus loin. "Il est évident, dit monsieur Théo Denis, que c'est à la grande dislocation Champlain St Laurent, qui absorba les efforts des poussées orogéniques venues de l'est, que les assises de la Plaine du St. Laurent doivent leur horizontalité relative. Aussi remarquet-on un contraste frappant entre les deux provinces géologiques voisines qui confinent le long de la ligne de faille. Comparées avec les couches des Appalaches, les différentes subdivisions du

Paléozoique de la Plaine Laurentienne n'ont pas été dérangées et se succèdent en stratification concordante relativement horizontale.

La carte géologique nous montre aussi que les subdivisions vont du Cambrien Supérieur (grés de Potsdam) à l'Ordovicien supérieur, (Schistes Lorraine) et qu'elles apparaissent rangées d'après leur âge, en bandes parallèles sur les pentes du massif Laurentien. Les formations les plus anciennes se rencontrent donc vers le nord de la plaine, tandis que les plus récentes apparaissent en bordure de la dislocation Champlain St Laurent.

L'épaisseur totale des couches Ordoviciennes est estinée à environ 4,350 pieds aux environs de Montréal. Dans l'ordre ascendant, nous trouvons après le Potsdam, formation néritique essentiellement constituée de conglomérats et grès très siliceux, classée dans le Cambrien supérieur, les étages suivants:

(a)—*Le Calcifêre ou Beeckmantown,* représenté par une épaisseur de 300 à 500 pieds de calcaires dolomitiques, siliceux ou argileux.

(b)—*Le Chazy,* comprenant surtout des calcaires fossilifères, des schistes et des grès.

(c)—*Le Trenton,* formation essentiellement calcaire, d'une puissance d'au moins 600 pieds, dans le district de Montréal.

(d)—*L'Utica,* formé de schistes plus ou moins bitumineux, d'une épaisseur estimée à 200 pieds.

(e)—*Les couches Lorraine,* lesquelles comprennent des amas très considérables de schistes, atteignant par endroits 2,000 pieds de puissance.

Le niveau très uniforme de la plaine Laurentienne, dont l'altitude moyenne ne dépasse pas 100 pieds, n'est brisé que par la série des collines Montérégiennes, protubérances d'origine éruptive, démantelées durant la longue époque d'érosion que subit le région à partir de la clôture de la période Dévonienne.

Durent l'époque Pléistocène, les nappes glaciaires descendues du Plateau Laurentien recouvrirent naturellement la Plaine du St Laurent, y amenant des débris de roches cristallines originaire du nord, tout en entamant profondement les assises Ordoviciennes du fond, constituées des roches relativement tendres énumérées plus haut. Le résultat fut que toute la surface de la Plaine du St Laurent fut recouverte d'un manteau d'argile à blocaux ou drift, souvent très calcaire, provenant de la moraine de fond, d'une épaisseur variable, mais pouvant dépasser 200 pieds. L'action glaciaire si préjudiciable aux possibilités agricoles sur le Plateau Laurentien s'est donc exercée entièrement en leur faveur dans la Plaine du St Laurent, en y déposant son abondante moulange représentée par d'énormes quantités d'argiles à blocaux.

Mais la formation du joyau de l'agriculture de la province de Québec demandait un travail de parachèvement, car si les boues glaciaires constituent généralement des terres d'excellente qualité au point de vue de la composition minéralogique et chimique, elles restent toujours d'un travail difficile et onéreux en raison de leur texture héterogène allant depuis l'argile impalpable jusqu'aux blocs erratiques de plusieurs verges cubes de volume.

Cette correction s'effectua de la plus heureuse façon durant le temps de transgression marine connu sous le nom d'Epoque Champlain, qui coincida avec la fin des temps glaciaires. Le retour de la mer fut amenéé, comme on le sait, par un affaissement général de la Plaine du St Laurent, atteignant 625 pieds par rapport au niveau actuel aux environs de Montréal.

Les différents cours d'eau aboutissant dans le vaste estuaire qui prit naissance y charrièrent un grand volume de materiaux provenant de l'affouillement des moraines et argiles à blocaux situées dans leur bassin hydrographique. Suivant la loi générale, les matériaux grossiers durent se déposer le long des lignes de rivage, sous forme de graviers et de sables caracterisés par la présence de nombreux coquillages marins dont les plus typiques sont les saxicaves; tandis que les matériaux plus fins, entraînés au large, se précipitèrent à l'état de bancs d'une argile fine, entièrement dépourvue de cailloux, dans les eaux plus profondes et non soumises à l'agitation, à laquelle on donna le nom d'argile à léda, autre mollusque d'eau salée, dont elle renferme souvent de nombreuses écailles. Cette argile, qui a été étudiée par Dawson et fort bien décrite dans son ouvrage intitulé *"Canadian Ice-Age"*, a donné naissance aux fameuses terres grises, de fertilité proverbiale, qu'on peut considérer comme la mine la plus précieuse des Basses terres laurentiennes.

On sait que la transgression marine de l'Age Champlain, qui noya toute la vallée du St Laurent jusqu'au pied des Grands Lacs, fut suivie d'un relèvement général, ou plutôt de plusieurs étapes sucessives de relèvement de la région qui ramenèrent le fleuve et son estuaire à leurs proportions actuelles. Chacune de ces étapes fut marquée par un renouveau d'activité érosive du grand cours d'eau et de ses affluents qui se mirent à recreuser leur lit plus ou moins profondément dans les alluvions meubles de l'age Champlain, jusqu'à travers les argiles à blocaux sous-jacentes, laissant de chaque coté une terrasse dont le niveau supérieur correspond à la plaine alluvionnaire précédente. Ces terrasses s'étagent maintenant depuis le niveau du fleuve actuel jusqu'à une hauteur de 500 à 600 pieds sur le versant des collines qui bordent ou sillonnent la Plaine du St Laurent. On peut notamment les observer d'une façons typique dans l'étagement de la ville de Montréal, sur les versants de la montagne..

Conclusions

Une première constation qui se dégage immédiatement de l'examen sommaire des trois provinces géologiques qui apparaissent si nettement sur une carte du Québec, c'est que, comparativement à son immense étendue. elle ne possède qu'une faible proportion de terres exploitées ou exploitables pai l'agriculture.

Aussi voyons-nous, d'après le recensement de 1911, qu'il n'y a avait à cette époque, sur une superficie totale de 218,723,687 acres, non compris l'Ungava, que 15,576,809 acres de terres occupées. De celles-ci, 8,147,633 acres représentaient des terres dites "améliorées", terme par lequel, il faut entendre des terres cultivées ou défrichées. Les terres non améliorées, qui occupent une superficie égale à la différence entre les deux chiffres, sont

évidemment représentées principalement par les pâturages, lots à bois, terrains rocheux et autres surfaces peu propres à la mise en culture proprement dite.

D'autre part, la superficie des terres domaniales divisées, considérées comme cultivables, dans les divers districts de colonisation était évaluée à 8,320,247 acres, au 30 juin 1925.

Une autre estimation, dont nous ne pouvons vérifier la source, fixe à environ 15,000,000 d'acres, soit l'équivalent de la superficie des terres actuellement occupées, la réserve totale des terrains encore colonisables dans toute l'étendue de la province.

Voici donc des faits que devraient bien noter ceux qui ne considérant que l'immensité de notre territoire, sont facilement portés à s'illusionner sur l'étendue des terres encore disponibles pour l'agriculture, et s'imaginent que le grand remède à l'émigration où à la désertion de nos anciennes paroisses est la conquête des terres neuves, le recul de la forêt devant l'agriculture, l'ouverture de nouveaux centres de colonisation capables de fournir la subsistance à un nombre presque illimité de travailleurs du sol. Certes, les réserves de terres labourables que le département de la colonisation pourra mettre à la disposition des vaillants colons que n'effraie pas la solitude, dans certaines parties excentriques de la province, sont encore imposantes et pourront accommoder un supplément respectable de population rurale, mais il ne faut jamais perdre de vue le principal fond agricole du territoire, constitué des terres les meilleures et les mieux situées, est et restera le petit triangle occupé en bonne partie déjà depuis les débuts la colonisation dans la région des Basses-terres du St Laurent, auquel il faut ajouter le bassin du Lac St Jean et certaines vallées fertiles de la région des Appalaches.

En second lieu, il est évident que l'immense province géologique du Plateau Laurentien, abstraction faite du vaste territoire de l'Ungava, dont nous n'avons d'ailleurs pas tenu compte dans le chiffre d'évaluation de la superficie totale du territoire du Québec, et pour lequel le climat est à priori un obstacle irréductible à toute colonisation, représente essentiellement une région forestière, qui devrait être mise en valeur comme telle. Si les sols forestiers n'ont qu'une assez faible importance économique, par unité de surface, en comparaison des terres cultivables, par leur étendue considé rable ils forment cependant une des grandes ressources naturelles de la province. Mais, l'expérience l'a trop souvent démontré, l'exploitation inconsidérée, de même que le défrichement inopportun des surfaces qui ne se prêtent qu'à l'état boisé, amènent la ruine complète du fond, et cela d'une façon beaucoup plus complète et irréparable que ne peut le faire l'épuisement des terres agricoles normales, par des méthodes de culture défectueuses.

Aussi ne pouvons-nous, en passant, que formuler le voeu que la génération actuelle arrive à se persuader une bonne fois qu'exploitation forestière ne signifie pas nécessairement destruction des ressources ligneuses, mais doit comporter un traitement rationnel qui, sacrifiant quelque peu sur les revenus immédiats, assure la continuité des rendements futurs. Pour cela, il faudrait abandonner l'aménagement des forêts aux ingénieurs forestiers qui ont étudié les méthodes européennes de conservation et de régénération des ter-

rains boisés, surtout dans les pays scandinaves, qui offrent tant d'analogies climatiques et géologiques avec notre territoire, et leur laisser toute initiative en la matière. On ne saurait trop le répéter non plus ; en sylviculture économique il importe avant tout de prévenir la ruine des étendues boisées ; le reboisement artificiel, qui n'est déjà guère praticable, économiquement parlant, sur de grandes surfaces en Europe, l'est encore moins en Amérique, eu égard au coût plus élevé de la main d'oeuvre et la lenteur du procédé. Il faut absolument adopter des modes de coupe qui assurent la régénération naturelle des essences ligneuses, tout en les protégeant contre les dangers de destruction par l'incendie toujours si menaçant au Canada.

Par un aménagement rationnel, en soumettant les étendues boisées à un régime d'exploitation régulier, on arrive non seulement à conserver les ressources forestières, mais encore à les enrichir, par la qualité surtout, comme la chose a été démontrée en Allemagne, dans les pays scandinaves et dans d'autres contrées.

Il faudra conclure en troisième lieu à l'importance primordiale, pour la solution du problème agricole de la province de Québec, de tirer tout le parti possible du principal fond de richesse agrologique, très limité, répétons-le, dont nous avons parlé, et cela en adoptant un système d'exploitation agricole plus scientifique, plus intensif. Développer cette question dans les traits principaux seulement demanderait tout un chapitre, aussi nous contenterons nous d'indiquer tout simplement les grands facteurs de cette exploitation plus méthodique qui devrait procurer une existence plus aisée à un plus grand nombre de travailleurs du sol dans les parties de culture ancienne de la province de Québec.

En premier lieu, il faut nommer la généralisation d'un système de rotation régulière dans lequel, chaque année, un quart ou un sixième de la surface cultivable, suivant que la durée de cette rotation est de quatre ou de six ans, sera en culture sarclée, ce qui suppose de hauts rendements, soit en plantes fourragères permettant le maintien d'un troupeau plus nombreux et mieux nourri, soit en plantes industrielles et en plantes maraîchères, suivant les situations :

Voilà qui peut paraître d'une simplicité élémentaire dans la mise en pratique, et, pourtant, je ne m'attends pas à contradiction si j'affirme que malgré les bulletins, les efforts des agronomes et l'exemple des fermes de démonstration, il n'y a pas un pour cent des cultivateurs de la province qui suivent une telle rotation. Nous ne pouvons nous attarder ici à l'explication de tout l'ensemble des causes qui mettent obstacle à l'accomplissement de cette révolution bienfaisante ; qu'il nous suffise de démontrer par cet exemple combien il est difficile de vaincre la routine en agriculture pour lui substituer un système basé sur un plan rationnellement conçu, exigeant un peu plus de réflexion, de travail et quelques avances de fonds. Car il faut observer, en second lieu, que cette culture plus intensive qu'implique l'adoption d'une rotation avec extension des cultures sarclées, nécessite aussi une meilleure fertilisation du sol, l'emploi d'engrais plus abondants, notamment l'application rationnelle de certains engrais complémentaires et d'amendements appropriés.

Ceci représente donc un deuxième point du programme à exécuter, d'ailleurs en connexion intime avec le premier.

Enfin, pour en assurer tout le succès désirable, il y aurait encore lieu d'y ajouter un troisième article, nous voulons mentionner l'étude systématique des sols et leur classification d'après leurs relations avec les phénomènes géologiques et les conditions climatiques, tel que cela se pratique sur une grande échelle aux Etats-Unis et, depuis quelques années, aussi dans l'Ontario et autres provinces du Dominion.

Ce travail servirait surtout à donner une base d'indications générales servant de point de départ aux expériences et démonstrations sur la fertilité des sols qui doivent être entreprises par les techniciens argicoles.

Et, en fin de compte, nous croyons pouvoir conclure à l'importance de la géologie dans la discussion des problêmes agricoles.

Cette science est non seulement fondamentale pour l'agronome qui doit s'occuper spécialement de toutes les questions concernant le sol, elle est encore nécessaire aux économistes et aux sociologues qui discutent des questions agraires et de sociologie.

Pour parler en connaissance de cause, établir des comparaisons, prononcer des jugements équitables dans toutes les questions où les ressources agraires d'un pays sont en jeu, ne devraient-ils pas posséder de bonnes notions de la géologie générale du pays, et une connaissance assez complète de sa géographie économique et de sa géographie physique, qui est la base de la première.

BOOK REVIEW.

LEHRBUCH DER AGRIKULTURCHEMIE. 1 Teil. Pflanzenernährungslehre. (Textbook of Agricultural Chemistry. Part 1. Plant Nutrition). Dr. E. Blanck. 207 pages. Berlin. Gebrüder Bornträger.

Two among the best known agricultural chemists in Germany have joined forces to provide students of their subject with a new and up-to-date textbook. If the first part,—plant nutrition—which appeared late in 1927, is an indication of the manner in which the whole vast subject is to be dealt with, the authors are to be congratulated on their undertaking. Dr. Blanck is director of the Institute of Agricultural Chemistry and Pedology at the University of Gottingen, while Dr. E. Haselhoff, under whose name the second part will shortly appear, is director of the Experiment Station, Harleshausen.

Students not thoroughly familiar with the German language will find Dr. Blanck's style particularly pleasing. It is more that of an amiable "raconteur" than that of the scientist who neglects form for contents, while at the same time no sacrifices have been made in accuracy and thoroughness.

The arrangement of the subject matter is rather original. The author begins with the substances obtained in the ether-extract of plants, notably chlorophyll, and makes the student acquainted in turn with fats and oils, waxes, phosphatides, etc. The next chapter deals with carbohydrates, beginning with the simpler monosaccharides, and, inserting the alkaloids as a logical introduction to the more complex nitrogen compounds, the author guides the reader through the maze of amino-acids, amines and proteins, in a manner which guarantees an easy understanding of the structure of these seemingly very complicated substances.

An equally valuable portion of the volume is devoted to the discussion of minerals which play a rôle in plant nutrition. Interspersed here and there are historical notes, although no attempt is made to cite literature at all extensively.

Part 2 of the book deals with the formation and metabolism of organic substances in the plant. Here the author deals with the plant as a living being. Assimilation, respiration, the metabolism of fats, nitrogen and carbohydrates, follow each other in logical sequence, always rendered in a simple language which recommends the book throughout to the English speaking reader, not only as a most modern source of information on plant nutrition, but as a pleasant way to become better acquainted with the reading of German. The writer has often observed that beginners were prompted to abandon the study of German because of the unfortunate habit of some German scientist to write in a most involved style. The more refreshing is it to note the pleasant contrast afforded by this author.

F.T.W.

CONCERNING THE C.S.T.A.

The International Education Board of New York, founded by Mr. John D. Rockefeller, Jr., in 1923, has placed a sum of $4,000 at the disposal of the C.S.T.A. The money is to be used in making a survey of graduate and research facilities available at Canadian agricultural colleges, as well as in the Federal and Provincial departments of agriculture, and in preparing and publishing a Graduate Calendar based upon such a survey. This donation is the result of a recommendation made by the C. S. T. A. Committee on Graduate Study at the annual meeting of the Society in June, 1926. The recommendation will be found in the following excerpt from the Committee's report:—

> "No attempt has been made to prepare a statement of the collective facilities available in Canada for graduate work. The Committee now proposes that this Society undertake the task of preparing such a statement, which would really be a graduate Calendar. Such a calendar should contain an official statement by each University of the courses of graduate grade available in that University, the library, laboratory and general research facilities, the lines of investigation being carried on by the various departments, a statement of the regulations governing registration, and general requirements, fees, etc. The Calendar should also contain a statement respecting the facilities available for graduate work in our Dominion and Provincial Departments of Agriculture. This Calendar would be placed in the hands of all members of the Society and graduating classes in Agriculture.
>
> It is at once obvious that such a piece of work could not be performed by a general committee. It would require the entire services of one man, who might be a special committee of one. It would be necessary that the person appointed should give his entire time to the task, for at least a period of six months. Respecting the question of remuneration and expenses, the Committee suggests that the obstacles are not insuperable. We do not think that any one would question the need of such a Calendar, or the value of the work proposed. In the performance of this task the Committee feels that the Society has an opportunity to perform a piece of constructive work that alone would justify its organization. The above is submitted as a recommendation of the Committee on Graduate Studies."

Financial assistance was sought from the International Education Board and at a meeting of the Board, held in New York City on February 24th, 1928, the sum of $4,000 was voted for the proposed survey.

The Society has been fortunate in arranging for the release of Dr. Robert Newton of the University of Alberta and he will undertake the survey in January, 1929. The graduate Calendar should be completed at the time of the ninth annual convention of the Society in June, 1929. Dr. Newton will confer with the International Education Board in New York City in June of this year, immediately after the Quebec Convention.

Notes and News.

The programme for the annual Convention is being rapidly completed and should be ready for printing before the end of April. A general outline can now be given, though there are many details that cannot be announced as yet.

The dates of the Convention are June 11th to 14th inclusive (Monday to Thursday). The mornings of Monday, Tuesday and Wednesday will be devoted to business meetings. On Monday afternoon the members will be received at Laval University and a series of lectures in Economics and Farm Management will be given. The four local branches in the Province of Quebec will give a complimentary banquet in the evening to the members from the other Provinces.

On Tuesday, there will be a motor excursion to Ste. Anne de la Pocatière, a distance of seventy-five miles. Luncheon, in picnic baskets, will be furnished en route, and, on arrival at about three p.m., visits will be made to the Dominion Experimental Farm and the Agricultural School. A banquet will be given to all the members before they leave for the return trip to Quebec.

On Wednesday, a trip will be made to the Dominion Experimental Station at Cap Rouge, fifteen miles from Quebec. This will be followed by a reception at "Spencerwood" the home of the Lieutenant-Governor, Hon. Narcisse Pérodeau. The official banquet from the Province of Quebec will be held at the Chateau Frontenac that evening.

The entire day on Thursday will be given up to group meetings and lectures in (1) Field Husbandry, (2) Animal Husbandry and (3) Horticulture. The Eastern Canada Society of Animal Production will hold their annual meeting that day and the Horticulture group of the C.S.T.A. will arrange the programme in this subject.

Several prominent agriculturists have been invited to give lectures at the group meetings and the following have already accepted: (1) Dr. A. Volkart of Zurich, Switzerland (forage crops), (2) Dr. E. C. Auchter, Head of the Department of Horticulture at the University of Maryland, (3) Dr. R. J. Garber, Professor of Agronomy at the University of West Virginia. Three other lecturers have also been invited and have not yet replied.

The Convention will close on Thursday evening with an informal party at Kent House (Montmorency Falls).

The foregoing will give members a rough idea of the many good things in store for those who can come to Quebec on June 11th. Details of the programme are in the hands of efficient committees in Quebec and a meeting of these committees has been called for April 14th. The final programme should be ready for printing shortly afterwards.

The attention of members is again directed to the importance of making hotel reservations through the General Secretary. Such reservations

must be made before May 15th, after which date hotels in Quebec will accept reservations for their regular tourist business. The City of Quebec is an extremely popular summer resort and tourist traffic in June is very heavy. Members who are going to the C.S.T.A. convention should notify the General Secretary *as soon as possible.*

During the past six weeks the General Secretary has attended the following local branch meetings:—

Ste. Anne de la Pocatière, P.Q. February 20th, Macdonald College, P.Q. February 29th, Quebec, P.Q. March 3rd, Toronto, Ont. March 9th, Cochrane, Ont. March 15th and 16th and Montreal, P.Q. March 24th. He will also attend a meeting of the Nova Scotia Branch at Truro on April 4th.

L. H. Newman (Toronto '03), Dominion Cerealist, is to be congratulated on the excellent little bulletin "Classification of Canadian Spring Wheat Varieties," (a paper which he presented to the Canadian Seed Growers' Association in June, 1926), recently published by the Dominion Department of Agriculture. It is well illustrated with drawings and photographs and is invaluable as a reference.

D. L. Bailey (Queens '18) has resigned his position as Senior Plant Pathologist at the Dominion Rust Research Laboratory, Winnipeg, to accept the Professorship of Plant Pathology at the University of Toronto. He assumes his new duties on April 1st.

F. F. McKenzie (British Columbia '21) is returning to the United States from Turkey in June. He has received the appointment of Assistant Professor of Animal Breeding at the University of Missouri.

L. M. Winters (Minnesota '19) has resigned as Professor of Animal Husbandry at the University of Saskatchewan and is returning to the University of Minnesota to take charge of the Graduate School of Animal Husbandry.

J. E. Whitelock (Toronto '22), Agricultural Representative at Brampton, Ontario, has been appointed an Assistant Director in the Agricultural Representatives Branch of the Ontario Department of Agriculture.

Fraser Ross (Toronto '22) has been transferred by the Maple Leaf Milling Company to Montreal, P.Q. His home address is 3626 Lorne Crescent, Montreal.

Lionel Stevenson (Toronto '12) who graduated from the Ontario Veterinary College two years ago, has been appointed to a new position in the Ontario Department of Agriculture, that of Animal Parisitologist. He has been Director of Extension at the Ontario Agricultural College for the past five years.

K. W. Neatby (Saskatchewan '24) who has been taking post graduate work at the University of Minnesota, has returned to the Dominion Rust Research Laboratory, Manitoba Agricultural College, Winnipeg, Man.

J. H. Robert, (Laval '23) has changed his address to Service de l'Horticulture, 2 St. Jacques, Montreal, P.Q.

The Civil Service Commission at Ottawa is advertising the following vacancies in the Federal Department of Agriculture:—

No. 13910. Assistant Entomologist for the Dominion Entomological Laboratory at Saskatoon, Sask. Salary $2,040 per annum.

No. 13911. Five Junior Entomologists, one for Alberta, three for Chatham, Ontario and one for Quebec, for temporary or seasonal employment at $135 per month.

Applications must reach the Secretary, Civil Service Commission, Ottawa, Ont., not later than April 12th, 1928.

Applications for Membership.

The following applications for regular membership have been received since March 1, 1928.:—

Victor E. Graham, (Saskatchewan, 1927, B.S.A.), Saskatoon, Sask.
David S. Kaufman, (Manitoba, 1927, B.S.A.), Winnipeg, Man.
Fergus Mutrie, (British Columbia, 1926, B.S.A.), Vernon, B.C.
F. Corminboeuf, (Montreal, 1927, B.S.A.), Montreal, P.Q.
R. H. Thexton, (Manitoba, 1923, B.S.A.), Winnipeg, Man.
George Knowles, (Toronto, 1922, B.S.A.), Ottawa, Ont.

Life Membership

Dr. L. S. Klinck, President of the University of British Columbia, is the third member of the Society to take out Life Membership. He was the first President of the C.S.T.A., holding the office from June, 1920, until June, 1922.

List of Members

The 1928 List of Members will not be ready until May. It will be published in group form, every member being assigned to those branches of agriculture in which he is especially interested. The difficulty of arranging the members into groups has caused some delay and it will be impossible to submit the final list to the printers before the end of April.

Convention Hotel Rates

The Chateau Frontenac at Quebec is offering a special rate of $8.00 per day for a double room (two beds), with private bath, for the Quebec Convention. The regular rate for this accommodation is $12.00 per day. As rooms at the Chateau are at a premium during the summer months, those who intend to stay at this hotel should make reservations through the General Secretary before May 15th.